Enlight Run Watershed Mine Drainage Assessment and Restoration Plan

Prepared for the Enlight Run Lakeside Watershed Association and the West Branch Area School District

By NMBS (New Miles of Blue Stream)

December 31, 2004

Funding for this project was provided by the Pennsylvania Department of Environmental Protection's Growing Greener Program

Document drafted by NMBS
www.newmilesofbluestream.com

Executive Summary

This project was undertaken to develop a restoration plan for the Emigh Run Watershed. This project was completed through a partnership with the Emigh Run Lakeside Watershed Association (ERLWA), the West Branch School District, and NMBS. The project partners worked cooperatively to complete the necessary tasks to bring this project to completion.

The Emigh Run watershed is located in Boggs and Morris Townships, Clearfield County, Pennsylvania and can be found on the USGS Philipsburg and Wallaceton 7.5-minute quadrangle topographic maps. Included in the watershed is the twenty-two acre Morrisdale Dam, located near Morrisdale. The main stem of Emigh Run flows 5.5 miles, with approximately 2.5 miles of tributaries located within the watershed.

The ERLWA, West Branch School District, and NMBS worked together to assess the quality of Emigh Run. A stream walk was conducted along the entire course of Emigh Run and 56 potential sampling locations were established. Forty-nine of these sampling points are located on discharges, and seven of them are located on the main stem of Emigh Run. A sampling plan was developed and approximately 40 priority sites were chosen for monthly sampling. The 40 sites were sampled monthly for one year for chemical parameters and flow rates.

Emigh Run can be divided into three stream sections. Section one is from the headwaters to the power line (ER-25). The second section is from the power line to ER-33 and the third section is from ER-33 to the mouth. The discharges in each section vary in their water quality. In section one, the discharges are characterized by high aluminum concentrations with varying amounts of iron and manganese. The discharges in section two are mainly iron laden discharges with low flow and minimal aluminum. In the lower section of the watershed, the discharges are large, laminar flow iron seeps with low to moderate levels of aluminum. These discharges have created huge “dead zones” visible as large iron mats.

Prioritization of treatment areas fall within three categories within the watershed. Priority Areas 1-7 are areas to be addressed in the short term for the improvement and restoration of Emigh Run and Morrisdale Dam. The priority areas are spread throughout the watershed and address moderate to high flow discharges with moderate to high levels of metal contamination. The second category includes those discharges related to the area being restored and remined on the

Avery Tipple and Graham Brothers sites by King Coal. There are four priority areas in this category. The discharges are of low to moderate flow, but are high in aluminum. The final category, "Other," includes additional priority discharges that may or may not need to be addressed once the other sites are mitigated. They are mostly low flow sites, but they do contain high levels of iron. They will be revisited for final prioritization when all other sites in the watershed are addressed.

The primary goal of the project partners is to restore Emigh Run from the headwaters, through the Morrisdale Dam, to the confluence with Moshannon Creek while involving West Branch school students in various aspects of the overall watershed restoration. Restoration of this watershed would fulfill the ultimate goal of reestablishing a cold water fishery within this stream. The reestablishment of a fishery in this stream would add fishing to the list of recreational opportunities that already exist within the watershed, such as, hiking and hunting. Restoration of this stream will be accomplished through 11 to 16 priority passive treatment projects. Abatement of AMD within this watershed will also help to improve the water quality of Moshannon Creek and the West Branch of the Susquehanna River.

The recommended treatment systems for Emigh Run are all passive systems, with the exception of one tributary where lime sand addition has been recommended. These passive treatment systems will use the most appropriate of the technologies available at the time of design and construction. The systems will consist of a combination of aerobic wetlands, vertical flow wetlands, limestone ponds, upflow ponds, aerating settling ponds, and manganese limestone beds. The cost estimate is broken down into the three categories. Priority areas 1-7 have an estimated cost of $1,354,710 while the sites related to remining activities have a cost estimate of $1,081,440. The "Other" priority category has a cost estimate of $224,500. These are conservative estimates made on the conceptual designs and are subject to change. Each estimate is addressed in the recommendations of treatment.

If the 11-16 priority treatment projects are complete, the Emigh Run watershed will be greatly improved. An aquatic community exists in small tributaries throughout the watershed. Improvements through treatment of the discharges should allow these species to expand to the main stem. Eventually, the goal is to reestablish Emigh Run as a fishery, along with restoring Morrisdale Dam as a recreational area for the community.

Table of Contents:

Watershed Vision

It is the vision of the partnership of the Emigh Run Lakeside Watershed Association and the West Branch School District to restore the Emigh Run watershed with the goal of improving water quality so that the stream will be able to once again support a cold water fishery that will compliment the recreational opportunities that already exist within the watershed.

It is the long term goals of the project partners to restore the Morrisdale Dam as a recreational area for the community. Five acres surrounding the dam will be donated to the ERLWA for the development of fishing and picnicking areas.

Restoration of this watershed will also help to improve the water quality of Moshannon Creek, and subsequently work towards the larger goal of the restoration of Moshannon Creek as is being pursued by the Moshannon Creek Watershed Coalition.

The restoration project also provides many hands-on learning opportunities for school students, youth groups, and the general public alike. Another vision of this project is to form a long-term stewardship in the watershed and to establish a relationship with the community that will work towards protecting and cleaning-up local watersheds

Introduction

In 2000, the Emigh Run Lakeside Watershed Association (ERLWA) was established with the primary goal of restoring Emigh Run and the Morrisdale Dam. Interested citizens joined together to form the group which would work towards making this goal a reality. The ERLWA formed partnerships throughout the watershed with local townships, sportsmen's groups, and most importantly the West Branch Area School District (WBSD).

Stream walks began in the Fall of 2001 to identify problem areas throughout the watershed. Water samples were also collected at this time through funding from WPCAMR. As discharges were located, the enormity of the problem facing the watershed was identified and grants were submitted to conduct a watershed assessment and to develop a restoration plan. After a few unsuccessful attempts to secure funding, a Growing Greener grant was submitted in partnership with the West Branch Area School District to secure funding not only for the restoration plan, but also for the development of a science curriculum to be used by both 7th and 12th graders. This grant was funded through the educational category of Growing Greener and the assessment began.

Through the partnership of ERLWA and WBSD, a stream reconnaissance was completed, and all seeps and discharges were identified and flagged. A sampling plan was developed and flow devices were installed. Monthly sampling was conducted by the environmental classes from WBSD under the supervision of NMBS. The students were a vital component to the completion of the watershed assessment.

Throughout the development of the restoration plan, prioritization of problem areas was occurring. Thus far, design and permitting monies have been secured for priority areas #1 and #2. Grants will continue to be submitted to insure the success and implementation of the restoration plan.

Watershed Background

Site Location:

The Emigh Run Watershed is located in Boggs and Morris Townships, Clearfield County, Pennsylvania. It can be found on the Philipsburg and Wallaceton 7.5-minute quadrangle USGS maps. Emigh Run originates near Wallaceton and flows in a southeasterly direction until its confluence with Moshannon Creek near Hawk Run. The nearest towns are Morrisdale and Philipsburg. The watershed is comprised of approximately 6.1 square miles. The main stem of Emigh Run is 5.5 miles long and approximately 2.5 miles of tributaries contribute to its flow. The twenty-two acre Morrisdale Dam is located directly off of State Route 53 near Morrisdale. It was built by a mining company in the 1800's and served as Morrisdale's primary drinking water supply for many years. The dam is now privately owned. With improved water quality, the dam could serve as prime habitat for aquatic and terrestrial wildlife. It could also provide the setting for many recreational activities including fishing, picnicking, swimming, and hiking.

Watershed History:

Generations of area residents have made their living and enjoyed recreation throughout the Emigh Run watershed. Mining began in the 1800s throughout the watershed and continues today. Extensive surface mining in the 1950s through the 1980s impacted both the landscape and water quality.

The Morrisdale Dam was once the drinking water supply for the town of Morrisdale and acted as a recreational area for the community. Families gathered for fishing and swimming before the mining impacts degraded the water quality. Local residents remember fishing the length of Emigh Run for bass, trout, and chubs, and local sportsmen's groups used to stock the stream with trout through the 1960s. Trumpeter swans also used the dam as a resting place during their yearly migration. Local residents remember aquatic life throughout the 1970s and used this as incentive in their fights against the Avery Tipple. It has been said that the winter after the tipple was built, coal washings could be seen through the length of the stream and in the dam itself. A massive fish kill occurred in 1982 through a slug of mine drainage that degraded water quality throughout the watershed.

Appendix B contains the historical water quality data and a table with the correlation to the sample locations conducted during the watershed assessment. Included in this appendix is a table of historical mining which includes the following information for each permit: mining permit, date issued, mining company, mine name and mining type. The historical data aids in completing the picture of mining activities and the subsequent affect on water quality. This historical data was used to develop the sampling plan and in the overall development of the restoration plan and treatment areas.

Watershed Geology/ Topography/ Soils:

The description of the Geology of Clearfield County can be found at the Penn State University libraries and a map can be found on page A-19. Also, additional information can be found in the Geologic Surveys for the Philipsburg and Houtzdale Quadrangles. Clearfield County encompasses 1130 square miles. Based on geologic maps of the area surrounding Emigh Run, the floodplain of much of this stream is covered with Quaternary alluvium, as would be expected. The rock units surrounding the tributaries are comprised of relatively flat-lying (mildly folded) rocks of the Pennsylvanian-age Allegheny and Conemaugh Groups (oldest to youngest). Within the Allegheny Group are the Laurel Run, Mineral Springs, Millstone Run, and Clearfield Creek Formations. The Emigh Run watershed lies within the Pittsburgh Plateau section of the Appalachian Plateaus province. To the southeast of the watershed is the Allegheny Front that separates the Appalachian Plateaus from the Valley and Ridge province. The local

terrain consists of broad, fairly rounded to almost flat divides separated by narrow V-shaped valleys. The older/larger streams, such as, Emigh Run are floored with alluvium, as stated above. This produces flat, narrow, swampy stream bottoms. The drainage pattern in this region is dendritic in nature. There is high-angle faulting intersecting the upper reaches of the stream. (It is possible that these faults have served to generate the zones of weakness that surface drainage took advantage of when down-cutting the landscape.) A great deal of mining has occurred on the ridgetops above Emigh Run and in the headwater regions of the stream and its tributaries. There are many abandoned drifts (underground coal mine openings) located within the watershed, especially near and upstream from the Morrisdale Dam. Coal resources that have been mined in the watershed include, but are not limited to, Upper Kittanning, Upper Freeport, and Middle Kittanning No. 1 coals.

There are thirteen soil units found along the main stem and tributaries of Emigh Run. They include but are not limited to the following: At, BrB, CoB, CoC, ErC, GlB, HbF, Ph, RbF, RcD, Uo, and WhB. These are not the only soil units found within the watershed. The most abundant soil type along the main stem corridor of Emigh Run is Atkins silt loam (At).

Atkins silt loam (At) -

This soil is nearly level, deep, poorly drained and found on flood plains which are frequently flooded. Slopes range from zero to three percent. The permeability is slow to moderate in the subsoil and moderately slow to rapid in the substratum, available water capacity is high, and runoff is very slow. Reaction in unlimed areas is strongly to very strongly acid. The seasonal high water table of this soil unit is between the surface and a depth of 1 foot. A slight hazard of erosion exists.

This soil is considered hydric and is also included on the list of Statewide Important Farmland Soils of Clearfield County, Pennsylvania; however, much of the soil surrounding this stream has been disturbed by surface mining. This soil unit belongs to Hydrologic Group D with very brief, frequent flooding from September through July. Frequent flooding and the high water table limit the use of this soil for most non-farm uses. It is especially unsuited to onsite waste disposal. According to the soil survey, Atkins silt loam is fairly well to well suited for wetland plants, openland, woodland, and wetland wildlife.

Brinkerton silt loam, 3 to 8 percent slopes (BrB) –

This soil unit is gently sloping, deep, and poorly drained. It is found on uplands. Permeability is moderate above the firm part of the subsoil and moderately slow to slow in the firm part, and runoff is slow. Reaction in unlimed areas is medium acid to very strongly acid. The seasonal high water table is from the surface to a depth of six inches, and the erosion hazard is moderate.

Most areas of this soil type are in woodland. The soil is also suited to some crops that tolerate seasonal wetness, pasture, and trees. Nonfarm uses of this soil are limited by the high water table and permeability. Within the Emigh Run watershed, Brinkerton silt loam is found in small areas along some of the tributaries. This soil is listed as a hydric soil.

Cookport channery loam, 3 to 8 percent slopes (CoB) –

This soil unit is gently sloping, deep, and moderately well drained. It is found on uplands and is listed as a Prime Farmland of Clearfield County. Permeability is moderate above the firm part of the soil, slow in the firm part, and moderately slow in the substratum. The available water capacity is moderate, and runoff is medium. The reaction in unlimed areas is strongly acid to extremely acid. The high water table is between 18 to 30 inches, and the erosion hazard is moderate.

Most areas of this soil are in woodland, and it is also well suited to cultivated crops, pasture, and tree production. Nonfarm uses are limited by the high water table and the slow permeability. Within the Emigh Run watershed, this soil unit is limited to some headwater areas.

Cookport channery loam, 8 to 15 percent slopes (CoC) –

This soil unit is characterized as sloping, deep, and moderately well drained. It is found on uplands, and is listed as Farmland of Statewide Importance. Permeability is moderate above the firm part of the subsoil, slow in the firm part, and moderately slow in the substratum. The available water capacity is moderate, and runoff is medium. Reaction in unlimed areas is strongly to extremely acid. The high water table is at a depth of 18 to 30 inches, and the erosion hazard is severe.

Most areas of this soil are in woodland, but they are also suited to cultivated crops, pasture, and tree production. Nonfarm uses are limited by the high water table, slope, and slow permeability in the first part of the subsoil. This soil type is found in the extreme headwater areas of the Emigh Run watershed.

Ernest silt loam, 15 to 25 percent slopes (ErD) –

This soil unit is steep, deep, and moderately well drained. Permeability is moderate above the firm part of the soil and moderately slow to slow in the firm part of the substratum. The available water capacity is moderate, and runoff is medium. Reaction in unlimed areas is strongly acid or very strongly acid. The high water table is between 18 and 36 inches, and the erosion hazard is severe.

Most areas of this soil are in woodland. This soil unit is suited to some cultivated crops, but crops are limited by the erosion hazard and slope. It is well suited to trees. Nonfarm uses are limited by the slope, high water table, and permeability. Within the Emigh Run watershed, this soil type is found in the headwaters and some of the tributaries.

Ernest silt loam, 8 to 15 percent slopes (ErC) –

Ernest silt loam, 8 to 15 percent slopes, is sloping, deep, and moderately well drained. It has moderately slow to slow permeability and a moderate available water capacity. Runoff is medium, and the erosion hazard of this soil unit is severe. The reaction in unlimed areas is strongly to very strongly acid. The seasonal high water table is 18 to 36 inches.

Ernest silt loam, 8 to 15 percent slopes is listed as a Farmland of Statewide Importance. Most areas of this soil are in woodland, but it is also suited to cropland and pasture. Nonfarm uses are limited by the high water table and permeability. This soil type is found in the extreme headwater areas of the Emigh Run watershed.

Gilpin channery silt loam, 3 to 8 percent slopes (GlB) –

This soil type is characterized as gently sloping, moderately deep, and well drained. It is found on uplands. Permeability is moderate, and the available water capacity is moderate. Runoff is medium, and the reaction in unlimed areas is strongly acid to extremely acid. The hazard of erosion is moderate.

Most areas of this soil are in native vegetation or woodland, but the soil is also suited to cultivated crops, pasture, and trees. Nonfarm uses are limited by the depth to bedrock which is approximately 31 inches. Within the Emigh Run watershed, this soil type is found in the headwaters of one of Emigh Run's main tributaries.

Hazleton very stony loam, 25 to 80 percent slopes (HbF) –

This soil unit is described as steep/very steep, deep, and well drained. It is found on uplands. Stones of 3 to 10 inch diameters cover approximately 3 to 15 percent of the surface. Permeability is moderately rapid to rapid, and the available water capacity is moderate. Runoff is medium, and the erosion hazard is moderate. Reaction in unlimed areas is strongly to extremely acid.

The steep slope and stony surface make this soil unit unsuitable for farming and nonfarm uses. It is suitable to tree cultivation. Within the Emigh Run watershed, this soil unit is found along the main stem of one of the tributaries to Emigh Run.

Philo silt loam (Ph) –

This soil unit is described as nearly level, deep, and moderately well drained. It is listed as Prime Farmland of Clearfield County, and is found on flood plains that are commonly flooded. Slopes range from 0 to 3 percent. Permeability is moderate in the subsoil and moderately rapid in the substratum. The available water capacity is high, and runoff is slow to very slow. Reaction in unlimed areas is strongly acid to medium acid. The erosion hazard is slight, and the high water table is at a depth of 1.5 to 3 feet.

Most areas of this soil are cultivated or in permanent hay or pasture. Other areas are in woodland or are used for housing and industry. This unit is suited to cultivated crops, pasture, and tree production. Nonfarm uses are limited by flooding and the seasonal high water table. This soil unit is found mostly in the upper reaches of the main stem of Emigh Run.

Rayne-Gilpin Complex, 15 to 25 percent slopes (RcD) –

This soil complex is moderately steep and well drained. It is found on uplands. This soil complex consists of 60 percent Rayne soil, 30 percent Gilpin soil, and 10 percent other soils. Permeability is moderate in both the Rayne and Gilpin soils. The available water capacity of the Rayne soils is moderate to high, and it is high in the Gilpin soils. Reaction in unlimed areas is strongly to very strongly acid in the Rayne soils and strongly to extremely acid in the Gilpin soils. Runoff is rapid in both soil types, and the erosion hazard of both soils is severe.

Most areas of this soil are in woodland, as it is well suited to trees. The depth to bedrock and the slope are the main limitations to nonfarm use. This soil complex is found in the upper reaches of some of the tributaries of Emigh Run.

Rayne channery silt loam, 25 to 65 percent slopes (RbF) –

This soil unit is described as steep/very steep, deep, and well drained. It is found on uplands. Permeability is moderate, and the available water capacity is high. Runoff is medium, and the erosion hazard is severe. Reaction in unlimed areas is very strongly acid or strongly acid.

This soil type is not suited to crops or pasture because of the steep slope and severe erosion hazard. However, it is suited to tree production. Most areas of this soil unit are in woodland. Nonfarm uses are limited by the steep slope. This soil unit is found in the extreme headwater areas of the Emigh Run watershed.

Udorthents, shale (Uo) –

This soil unit is nearly level to very steep and well drained to moderately well drained. It is found in uplands in areas that have been surface mined. Slopes vary from 0 to 80 percent. This soil unit may

include areas that have not been altered by mining, areas of mine wash, mine dump, sandstone quarries, and sand and gravel pits. Permeability is slow to rapid, and the available water capacity is low to high. Runoff is slow to very rapid depending on slope and cover. Reaction in unlimed areas is strongly acid to extremely acid. The seasonal high water table is 24 to 36 inches, and the erosion hazard is moderate to very severe.

Soil uses depend on many variables because of the wide range of properties encompassed by this soil unit and varying degrees of reclamation in different areas with this soil type. Udorthents soil is found in many areas within the Emigh Run watershed.

Wharton silt loam, 3 to 8 percent slopes (WhB) –

This soil unit is gently sloping, deep, moderately well drained and found on uplands. It is listed as Prime Farmland of Clearfield County. Permeability is slow or moderately slow, and the available water capacity is high. Runoff is medium, and the reaction in unlimed areas is strongly acid or very strongly acid. The seasonal high water table is 18 to 36 inches, and the erosion hazard is moderate.

Most areas of this soil are in woodland, are cultivated, or are in permanent hay. Some areas are used for pasture, housing, or industry. The soil is also suited to cultivated crops, pasture, and trees. Nonfarm uses are limited by the high water table and permeability. This soil type is found along one of the tributaries entering Emigh Run from the right side of the watershed.

A soil name map can be seen on page A-18. The map depicts the dominant soils found in the watershed as described above. For those requiring a more explicit view of the data, the source is referenced on the map.

Land Use:

The Emigh Run watershed has been extensively mined since the 1800s. Both underground and surface mining have affected the landscape of the watershed and degraded the water quality of the stream. Minimal logging has also occurred at various times within the watershed up until recent times. At this time, much of the watershed is either reclaimed surface mines or forested areas. There are no industrial or other water quality impacts in the watershed.

Cultural:

The nearest communities to the Emigh Run watershed are Morrisdale, Philipsburg, and Hawk Run. According to the 2000 US Census report, Morrisdale has a population of 3916 with an average household of 2.61 people. Philipsburg has a population of 8425 with an average household of 2.30 people. Between the Morrisdale Dam and the confluence with Moshannon Creek, Emigh Run flows through the village of Hawk Run. The population of Hawk Run is 422 with an average household of 2.20 people. Hawk Run does not have a sewage treatment facility, so sewage discharges from private systems may be affecting water quality in this stretch of stream.

Mining

Mining History:

Extensive deep mining and Pre Act surface mining have occurred within the Emigh Run watershed from the 1800s until the present. Coal was the main resource extracted by mining activities although some clay mining may have taken place in the watershed, as well. See Appendix B for tables of historical mining and page A-5 for mapping of the mining activities. These historical mining permits were researched for water quality to include in the database and can be found in Appendix B.

 # 263M38

This mine was located in Boggs Township, Clearfield County. The operator was Thompson Brothers Coal Company. The receiving stream is a tributary to Laurel Run.

#18468-M

This mine was located in Boggs Township, Clearfield County. The operator was Thompson Brothers Coal Company. The receiving stream is Laurel Run.

#3267BSM37 – Thompson #106 Strip

This mine is located in Boggs Township, Clearfield County on the Robert Bailey estate. The operator was Thompson Coal Company. Coal seams that were mined include the C' and D. Related permits include 3266BSM15 and 3266BSM7.

#3268BSM31 – Thompson #001 Strip Mine

This mine was located in Boggs and Morris Townships, Clearfield County. The operator was Thompson Coal Company. The landowners are W.T. Mease and General Refractories. Coal seams mined include A, B, B', C, and C'. This mining activity affected 15.51 acres. The receiving stream is Emigh Run.

#262M61 – Turner Strip Mine on C.I. Wolfe Tract

This mine was located in Boggs Township. The operator was W.K. Turner and Sons. The B coal seam was mined under this permit. The receiving stream is Laurel Run. Related permits include 263M63.

#32266BSM10 – Morrisdale Strip

This mine was located in Morris Township. The operator was Thompson Brothers Coal Company. Landowners are Siegfried, S. Raines, and the Mull Estate. Forty-eight acres were affected by this mine. Coal seams mined under this permit include the C' seam. The receiving stream is Emigh Run.

#262M49 – Maney Stripping

This mine was located in Morris Township. The operator was Homer Maney. Landowners are the Thompson Estate and the R.H. Mull Estate. Approximately 1.5 acres were affected. It is unknown what seams were mined. Other related coal operators include Meyer Brothers.

#17820149 – Dunlap

This mine was located in Boggs Township. The issuance date was January 1964. Permitted seams include Clarion #1,2,3 and the Lower Kittanning. Fifty-six acres were affected. The receiving waters are Emigh Run.

#17813055 – Emigh #1

This mine was located in Morris Township. Five hundred seventy-nine coal acres were affected. The coal seams mined include the Upper Freeport, Lower Freeport, Upper Kittanning, Middle Kittanning, Lower Kittanning, and Clarion. The receiving waters are an unnamed tributary to Laurel Run.

#17841606 – Van Tipple

This was a renewal application issued 7/10/86 for reclamation only. The operator was Avery Coal Company. The receiving stream is Emigh Run with some drainage to Moravian Run. The following is a list of mines that were either abandoned in the past or active at the time the permit was issued that are within 1000 ft of the permitted area:

- Graham Brothers- #17820149
- Thompson and Philips Coal Co.- abandoned surface mining (Clarion Coal)
- Bob Bailey Co.- abandoned surface mining (LK)
- House coal and prospect drifts- abandoned underground mine (LK)
- Prospect drift- abandoned underground mine (Clarion)

#17810104 – Morris #2

This mine was located in Decatur, Morris, and Boggs Townships. The operator was Thompson Brothers Coal Company. Approximately 611 coal acres were affected. Coal seams mined include the Lower Freeport, Upper Kittanning, Middle Kittanning, Lower Kittanning, and Clarion. The receiving waters are two unnamed tributaries to Laurel Run.

#3266BSM10 – Emigh #1

This mine is located in Morris Township. The operator was Thompson Brothers Coal Company. Coal seams mined included Upper and Lower Freeport, Upper, Middle and Lower Kittanning, and Clarion. The surface area affected was 611 acres, and the coal acres affected were 579. The receiving stream is an unnamed tributary to Laurel Run. This permit is updated and superceded by permit #17810155 (17813055). There are many abandoned mine workings within and surrounding the permitted area. The names, operators and permit numbers are unknown for the majority of these mines. However, there are several that were mined by Thompson Brothers and another by E.M Brown Contracting. Some of these sites have been backfilled while others have only been partially backfilled.

#17870129 – Emigh #2

This mine is located in Morris Township. The permit was renewed in June of 2003 and will expire in June of 2008. The operator is Sky Haven Coal, Inc. Permitted seams include the Upper and Lower Freeport, the Upper Kittanning, and the Upper Kittanning rider. The receiving stream is Emigh Run. Underground mines affected by this operation include the following:

- Guion Mine
- Watson Mine- permit #14358
- Decatur #9
- K & J #3
- Decatur #2
- Swede’s Mine
- Decatur #5
- Decatur #1

In all, the permitted site is in close proximity to 22 mine sites and extensive deep mine complexes.

The Department of the Interior, Office of Surface Mining Reclamation and Enforcement, was contacted to conduct a search of the deep mining that occurred within the watershed. They sent a Works Progress Map (WPA) showing the extent of underground mining in the watershed. Existing permit maps were also researched and the resulting permitted areas are displayed on page A-5.

AML:

There is minimal AML land within the watershed. The mining activities within the watershed have been reclaimed or are at this time being completed. One small area containing spoil remains and small seeps emanate from it and flow directly into the stream. This site will need to be addressed. This area is the only reclamation area in the watershed and is identified with discharge ER-32. A reclamation plan and construction of treatment systems are described in the priority area section of the restoration plan.

Current Mining:

Surface mining is currently occurring within the Emigh Run watershed. King Coal and Sky Haven both have active mining permits within the watershed, and King Coal is currently remining one area. This will lead to the reclamation of a large open pit and an abandoned tipple area (see page A-5). This remining will hopefully aid in abating some of the water quality problems associated with discharges emanating from the site.

Reclamation Efforts:

As already stated, King Coal Company is in the headwaters of Emigh Run conducting both remining and reclamation activities. They are at this time reclaiming a large abandoned highwall on the Graham Brothers site, along with activities at the Avery Tipple site (see Page A-5). As part of their efforts, they are adding substantial amounts of lime to their backfill which should aid in the improvement of water quality at four discharges which need treatment at this time. Their efforts should both decrease the flow of the discharges and also improve the water quality. King Coal has offered to be a partner in the restoration efforts of Emigh Run through equipment donation.

Remining Potential:

Remining is currently taking place within the watershed by the King Coal Company. Through this remining effort, it is hoped that reclamation of some areas will alleviate some of the aesthetic problems, as well as, some of the discharges that are affecting the stream. No other areas were identified in the watershed to be candidates for remining.

Data Collection

Field Reconnaissance:

Members of the ERLWA, students from West Branch School District, and NMBS representatives completed several stream walks along the course of Emigh Run in preparation for the initial Growing Greener Grant Application. Baseline water quality data was collected by the watershed association during a stream walk conducted in May 2001. Samples were collected for water quality analysis and discharges were identified and flagged. Funds from WPCAMR were used to conduct this initial investigation, and the DEP provided the water quality testing at no charge to the ERLWA.

On September 12, 2001, another stream walk was conducted between ER8 and ER9 in the hopes that the primary source of pollution to Emigh Run would be identified in that area. This stream walk was funded by WPCAMR. During this stream walk discharges to Emigh Run were identified, flagged, and measured for the installation of flow devices. Another stream walk was conducted in this same area (ER8 and ER9) on October 30, 2001. At this time, more measurements for flow devices were obtained and water samples were collected for analysis. This data was then used to develop a monitoring plan for the winter of 2001-2002.

On November 15, 2001, field reconnaissance was conducted from the Morrisdale Dam to approximately ER7. The goal of this walk was to show students from the West Branch School District how to identify and flag discharges and collect water samples. Finally, on January 18, 2002, all remaining areas of Emigh Run were investigated during a stream walk. Flagging of discharges was completed and GPS coordinates were obtained for all of the discharges.

Of all of the discharges that were identified and flagged during the various stream walks, 56 monitoring points were established. These points were sampled at various intervals, from one to twelve times over the period of a year, based on how significantly they seemed to be affecting the water quality of Emigh Run. These monitoring points, their descriptions, latitude and longitude, and number of times sampled can be found in Table 1.

Historical Data:

All of the available historical mining permits were obtained from PADEP and researched for water quality data (see Appendix B). The historical water quality data was included in the database and used to evaluate discharges over time.

Documentation of Problem Areas:

1. Water Samples: Table 1 represents the sampling locations on Emigh Run. The number of times each location was sampled is included in the table. The table contains the monitoring point, sample description and latitude and longitude. Pages A-6 through A-9 are maps of the sample locations.

Table 1: Sampling Plan

Monitoring Point	Description	Latitude	Longitude	Times sampled
ER-1	Headwaters of Emigh Run	40.95342	-78.27486	12
SPRING	Spring near headwaters on, left	40.95386	-78.2735	16
ER-2	Stream sample below spoil area in the headwaters, below where SPRING enters	40.95275	-78.27242	11
ER-3	Seepage from wet moss area, right	40.95169	-78.27169	3
ER-4	Small tributary to Emigh Run , right	40.95139	-78.27139	1
ER-5	Small tributary to Emigh Run , right	40.95117	-78.27064	1
ER-6	Large iron seep from toe of spoil, no flow device, left	40.95083	-78.26975	9
ER-7	Seepage with no discrete source, left	40.94986	-78.26819	4
ER-8	Seepage on stream bank, right	40.94933	-78.26719	10
ER-9	Discharge from Avery tipple, left	40.94878	-78.26686	11
ER-10	Discharge from Avery tipple, left	40.94892	-78.26653	11
ER-11	Seepage area, left	40.94847	-78.26619	9
ER-12	Discharge from Avery tipple, left	40.94839	-78.26575	7

Monitoring Point	Description	Latitude	Longitude	Times sampled
ER-13	Discharge from toe of spoil of reclaimed area, right	40.94781	-78.26567	12
ER-14	Discharge from toe of spoil of reclaimed area, right	40.94786	-78.26556	7
ER-15	Seepage area, left	40.94781	-78.26536	8
ER-16	Seepage area, right	40.94778	-78.26531	No data
ER-17	Discharge from Avery tipple, down road, left	40.94764	-78.26467	No data
ER-18	Seepage area, left	40.94714	-78.26428	7
ER-19	Seepage area, right	40.94689	-78.26417	No data
ER-20	Seepage area, right	40.94647	-78.26331	2
ER-21	Small tributary, right	40.94578	-78.263	7
ER-22	Seepage area, right	40.94494	-78.26253	4
ER-23	Seepage area, right	40.94414	-78.2605	6
ER-24	Seepage under power line, left	40.94342	-78.25783	No data
ER-25	Stream sample at power line	40.94303	-78.25731	11
ER-26	Seepage area at power line, left	40.94283	-78.25686	No data
ER-27	Spring under power line, right	40.94233	-78.25653	6
ER-28	Small seepage channel, right	40.94189	-78.25458	10
ER-29	Seepage area, left	40.94194	-78.25428	10
ER-30	Iron laden seep, left	40.9415	-78.25319	5
ER-31	Large iron laden seep, right	40.94139	-78.25281	12
ER-32	Iron seepage along reclamation area, right	40.94128	-78.25219	11
ER-33	Stream sample below reclamation area	40.94106	-78.25142	11
ER-34	Seepage area, right	40.94108	-78.25083	10
ER-35	Iron laden seepage of laminar flow, right	40.94108	-78.25044	12
ER-36	Large iron seep, left	40.94069	-78.24911	12
ER-37	Large iron seepage collecting in channel, left	40.94031	-78.24847	5
ER-37B				2
ER-38	Channel from wetland area, left	40.9405	-78.24647	11
ER-39	Small tributary to Emigh Run, left	40.94042	-78.24661	12
ER-40	Large iron seep, right	40.94008	-78.24642	8
ER-41	Iron seep, right	40.94072	-78.23333	8
ER-42	Iron seep with disperse flow, right	40.94022	-78.24517	1
ER-43	Stream sample below large swamp	40.93947	-78.24361	12
ER-44	Iron seep with disperse flow, right	40.93933	-78.24372	12
ER-45	Iron seep with disperse flow, right	40.93855	-78.24193	11
ER-46	Seepage area, left	40.93842	-78.2412	10
ER-47	Seepage area, left	40.93813	-78.24107	No data
ER-48	Seepage area, right	40.93728	-78.24084	12
ER-49	Seepage area, left	40.93727	-78.24	11
ER-50	Groundwater flow, left	40.93726	-78.23987	10
ER-51	Seepage area, left	40.93697	-78.93697	7

Monitoring Point	Description	Latitude	Longitude	Times sampled
ER-52	Seepage area, right			8
ER-53	Small tributary, left	40.93716	-78.23497	12
ER-54	Stream sample at haul road	40.93382	-78.22872	7
ER-55	Stream sample below the Morrisdale Dam	40.93189	-78.22455	11
ER-56	Mouth of Emigh Run before Moshannon Creek	40.9174	-78.20806	2

2. Abandoned Mine Lands: See page A-5 for a map of the historical mining in the area. The AML lands of the Avery Tipple and Graham Bothers site are both being addressed by the remining activities of King Coal in the headwaters.
3. Coal refuse areas: There is one small coal refuse/spoil area located on Emigh Run. It is a flat area located on both sides of the stream and in the stream. It is associated with ER-32 and is the only reclamation project in the watershed.

Permission:

Permission was obtained for reconnaissance, flow device installation, and monthly sampling from all property owners in the watershed. All participants signed waivers to protect the landowners. Permission for treatment system construction will need to be obtained as we progress through the watershed.

Property Ownership:

List of Property Owners on Emigh Run working from Headwaters Downstream

1. Keystone Land and Timber
2. Dennis Cole, et ux.
3. Duane Knepp, et ux.
4. William Downey
5. W. Mease
6. Madelyn Dudley
7. Marian Merritts et al
8. Michael Rowles
9. Anthony Mull
10. Bernice Shimel
11. Larry Owens et ux
12. Daniel Yanock
13. William Wagner
14. Gary Berkley et al
15. David Mignot
16. Dorothy Hess

Development of Monitoring Plan:

A monitoring plan was developed after the initial reconnaissance. The sampling plan focused on the significant mine drainage discharges and appropriate stream samples. See Table 1 for the list of sampling points and the number of times the samples were collected. Significant discharges were those with flow rates greater than 10 gpm and with pH less than 4.5. Monthly samples were collected on all significant discharges with additional sampling money spent at “grab” samples throughout the watershed.

Sampling Methods:

NMBS trained members of the ERLWA and students from the West Branch School District to conduct the monthly sampling. They were trained to properly conduct field chemistry tests, collect water samples, and measure flow rates.

Samplers were trained to collect pH, conductivity, and temperature measurements in the field. A NMBS representative reviewed proper use and care of each of the pieces of equipment required for these measurements.

A NMBS representative took samplers into the field and identified the points that were selected for monitoring and reviewed proper sampling methods with samplers at each of these sites. In addition, school students were supervised in the field by a NMBS representative or an ERLWA member at all times to insure proper data collection techniques.

The sampling methods used require that samples be taken as close to the source as possible. Samplers were directed to take samples in a section of the stream or discharge where flow is concentrated to provide the best representation of the chemical properties and to avoid sampling in pooled backwater areas or areas that are littered with decaying organic matter. Samplers were also directed to avoid areas that contain heavy concentrations of aquatic vegetation.

Samplers were taught to collect water samples in a manner that would prevent contamination. These steps included the exclusive use of bottles supplied by the lab and the technique of field rinsing equipment. Field rinsing was used to equilibrate the equipment to the sample environment; this was also done to ensure that all cleaning solution residues had been removed before sampling began.

Samplers were taught to rinse and then fill bottles in a manner that minimizes contact with the air. The exposure of the sample to the atmosphere can increase the dissolved oxygen concentration, causing reduced metal ions to oxidize and precipitate as hydroxides. The precipitation of iron and other metal hydroxides can result in lower concentrations of iron and co-precipitating metals in the analyzed sample.

Samplers were instructed to keep bottles cool as soon as possible. Provisions were made as part of the sampling plan to ensure prompt delivery of samples to the lab.

Samplers were taught to use a water resistant field book to record sampling information in the field. The sampling information includes date, sample name, field pH, field conductivity, flow, temperature, and weather conditions. Samplers were also directed to always be aware of and record potential sources of contamination at any field site.

Samplers were instructed to properly label bottles. These labels were the same as those recorded on the chain of custody that was sent with the bottles to the lab. A NMBS representative maintained responsibility for filling out the chain of custody and any additional lab paperwork that was required.

Water Quality Measurements:

Water samples were analyzed for mine drainage parameters. The pH, conductivity, and temperature were measured in the field. The pH and conductivity were measured using hand held Testr's by Oakton and temperature was measured with a standard thermometer. The meters were calibrated with buffer solutions prior to each use.

Iron, aluminum, manganese, acidity, alkalinity, lab pH, lab conductivity, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), and sulfates were measured in the laboratory. Mahaffey Laboratory, Ltd. performed the analyses using standard methods. Samples for metals were preserved in the field by adding five drops of nitric acid. None of the samples were filtered, so they represent total metal concentrations.

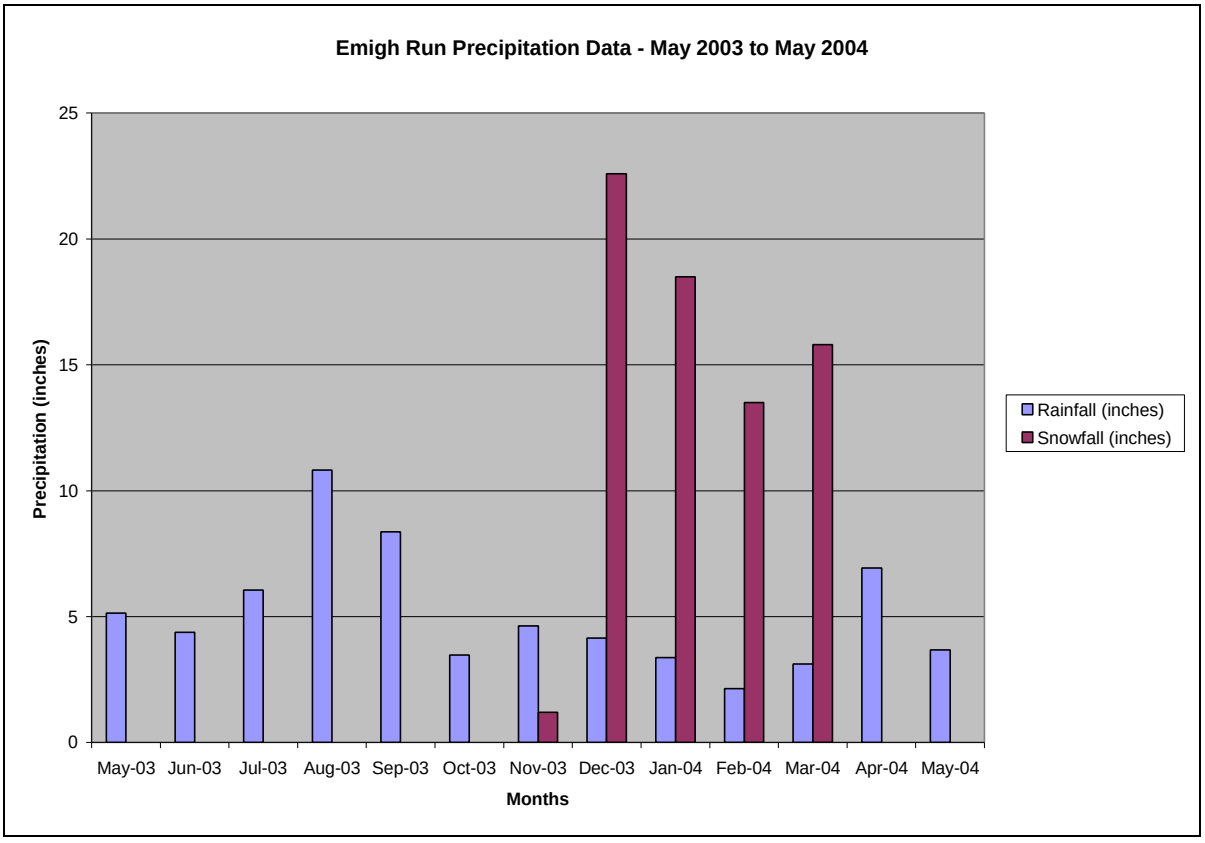
Flow Rate:

V-notch weirs were installed at sampling locations. The water flow height over the weir was measured and gallons per minute (gpm) were calculated. Pipes were installed at other locations and a bucket and stopwatch were used for the "timed volume" method. Flow data was also gathered using a Price Type AA flow meter.

Precipitation during Sampling Period:

As part of the sampling event, temperature and weather conditions were recorded in the field books. Precipitation events can affect the chemistry of the samples either by dilution or causing flush events. These recorded conditions were considered in the final site evaluations.

Total rainfall during the 12-month sampling period is also important in the overall evaluation of the remediation efforts. Drought years versus high water years can affect flow rates and may change the overall design of the treatment systems. The 12-month sampling period for the Emigh Run watershed assessment is from May 2003 through May 2004.



This graph represents the precipitation totals during the 12-month sampling period for the development of this restoration plan. Daily precipitation totals were added to produce the monthly totals found on this graph. Data was obtained from http://pasc.met.psu.edu/IA.

Mapping

Location maps

The location of the Emigh Run watershed can be found on page A-2. This map displays Pennsylvania and the location of the Emigh Run watershed within the Commonwealth. A map that displays the location of the Emigh Run watershed in the context of the surrounding municipalities is found on page A-3.

Stream Quality

Page A-4 displays a color coded version of Emigh Run. The variation in color describes the quality of the stream as it runs from headwaters to mouth (based upon the sampling which was done).

Mine Areas

Page A-5 is a map displaying the Emigh Run watershed and the position of underground and other permitted mining operations within the watershed boundary. Permitted areas include both areas for surface mining and areas permitted for refuse storage.

Monitoring Program

Pages A-6 through A-15 represent the historical sampling and present sampling plan on Emigh Run. Page A-6 displays the Emigh Run watershed, parts of the surrounding streams, and the position of monthly sampling points on the topographic quadrangle. A-7 displays the Emigh Run watershed, parts of the surrounding streams, and the position of monthly sampling points as divided into stream sections. The watershed and number of sample points make it cumbersome to view in its entirety. A-8 and A-9 are two other sections showing the position of monthly sampling. A-10 displays the Emigh Run watershed, parts of the surrounding streams and the position of the historical sampling points. A-11 through A-14 show the historical sampling points broken into sections. A-15 includes quarterly and grab samples that were sampled as part of the watershed assessment.

Treatment Areas

Pages A-16 and A-17 represent the proposed treatment areas within the Emigh Run watershed. A-16 displays the proposed treatment areas against the boundary of the Emigh Run watershed. A-17 displays the proposed treatment areas against the boundary of the Emigh Run watershed; this map also displays the appropriate portions of the USGS quad maps for the area.

The design and layout of treatment areas can be seen in Appendix C. These are detailed on pages C-1 through C-16.

Reclamation Areas

The only reclamation area in the watershed is associated with discharge ER-32, no separate map was made. Other reclamation activities in the watershed are being conducted by King Coal and are occurring in the headwaters of Emigh Run.

Data Analysis

The sampling data for each sample location can be found in the following sections. Flow values at each point were collected and samples were analyzed for pH, conductivity, acidity, aluminum, iron, manganese, and sulfate. The loadings for acidity, aluminum, and iron are calculated and in each table. Each table contains not only the raw water data, but also an average value for each parameter, the maximum value, the minimum value, and the 75% and 90% confidence intervals for each parameter.

Discharge Areas/Water Quality Data

ER-1

Table 2: Water Chemistry for ER-1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	30	4	227	44	15.9123	0	0.07	0.0253	5.1	2.56	85
6/17/03	12	4.1	225	48	6.9435	2	0.37	0.0535	5.9	2.67	79
7/23/03	12	3.9	223	40	5.7863	0	1.22	0.1764	4.57	3.19	85
8/28/03	12	3.9	214	40	5.7863	0	1.93	0.2791	4.18	3.59	67
9/18/03	7.5	4	235	50	4.5205	1	1.04	0.094	5.36	3.34	74
10/22/03	14	4.1	260	48	8.1008	4	0.38	0.0641	5.41	3.66	86
11/18/03	120	4	189	32	46.2904	0	2	2.8931	4.11	2.52	64
12/18/03	40	4.2	254	46	22.1808	3	0.07	0.0337	5.83	2.72	80
1/22/04	13	4.3	244	63	9.8728	3	0.17	0.0266	5.83	2.6	71
3/18/04	25	4.2	229	42	12.6575	3	0.08	0.0241	5.45	2.32	72
4/21/04	30	4	220	42	15.189	0	0.05	0.018	5.09	2.28	79
5/26/04	60	4	236	43	31.1013	0	0.25	0.1808	5.16	2.83	64
Ave	31.292	4.058	229.667	44.833	15.362	1.333	0.636	0.322	5.166	2.857	75.5
Max	120	4.3	260	63	46.29	4	2	2.893	5.9	3.66	86
Min	7.5	3.9	189	32	4.521	0	0.05	0.018	4.11	2.28	64
75% Conf	41.401	4.098	235.615	47.2	19.328	1.828	0.867	0.581	5.359	3.007	78.048
90% Conf	45.753	4.115	238.175	48.218	21.036	2.041	0.967	0.692	5.442	3.072	79.145

ER-2

Table 3: Water Chemistry for ER-2

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	58.17	3.5	335	48	33.6589	0	1.39	0.9747	3.24	2.65	92
6/17/03	15	3.4	362	59	10.6684	0	1.39	0.2513	3.24	2.86	103
7/23/03	25.32	3.3	408	54	16.4822	0	1.67	0.5097	2.79	3.2	100
8/28/03	16.54	3.4	344	47	9.3711	0	2	0.3987	2.7	3.69	88
9/18/03	35	3.4	409	61	25.7369	0	2.34	0.9872	3.16	3.49	103
10/22/03	3	3.4	409	53	1.9167	0	1.98	0.0716	2.9	3.75	101
12/18/03	65	3.7	330	44	34.4767	0	2.46	1.9275	4.51	3.31	86
1/22/04	25	3.7	381	66	19.8904	0	2.57	0.7745	4.06	3.31	92
3/18/04		3.7	334	47		0	2.38		4.63	3.31	92
4/21/04	46.32	3.6	330	45	25.127	0	2.34	1.3066	3.9	2.81	91
5/26/04	113	3.6	321	44	59.9364	0	1.37	1.8662	3.44	3.05	75
Ave	40.235	3.518	360.273	51.636	23.726	0	1.99	0.907	3.506	3.221	93
Max	113	3.7	409	66	59.936	0	2.57	1.928	4.63	3.75	103
Min	3	3.3	321	44	1.917	0	1.37	0.072	2.7	2.65	75
75% Conf	51.345	3.567	371.928	54.138	29.42	0	2.144	1.128	3.729	3.338	95.801
90% Conf	56.127	3.588	376.944	55.215	31.87	0	2.21	1.223	3.825	3.388	97.007

SPRING

Table 4: Water Chemistry for SPRING

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/12/01		4.1	236	22		2	0.18		1.91	1.69	73
10/30/01		4.2	149	14		4	0.14		1.12	0.77	50
5/12/03	0.75	4.2	223	30	0.2712	2	0.08	0.0007	2.75	1.85	78
6/17/03	2.5	4.1	233	40	1.2054	2	1.03	0.031	5.25	2.62	86
7/23/03	2	4	236	28	0.675	0	0.12	0.0028	3.85	2.72	83
8/28/03	5.5	4.1	209	27	1.7901	2	0.22	0.0145	2.4	3.94	63
9/18/03	4.5	4.1	236	38	2.0613	2	0.27	0.0146	3.24	3.51	73
10/22/03	6	4.2	252	30	2.1698	4	0.29	0.0209	2.69	3.2	74
11/18/03		4.2	119	8		4	0.92		1.12	1.48	34
12/18/03	25	4.4	183	21	6.3287	4	0.12	0.0361	2.19	1.9	52
1/22/04	5	4.4	253	52	3.1342	4	0.23	0.0138	4.15	2.98	73
3/18/04		4.5	221	31		5	0.1		3.66	2.19	73
4/21/04		4.1	230	37		1	0.15		4.57	2.67	79
5/26/04	6.85	4.1	219	27	2.2295	1	0.33	0.0272	2.24	2.67	55

ER-6

Table 5: Water Chemistry for ER-6

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/17/03		3.3	2010	351		0	28.3		27	41.5	1369
7/23/03		3.3	2060	340		0	35.9		27.4	45.6	1383
8/28/03		3.2	2010	312		0	40.5		26.1	44.3	1143
9/18/03		3.3	2410	408		0	26.1		28.4	43.9	1318
10/22/03	6	3.3	2120	300	21.6986	0	28.4	2.0541	23.8	41.6	1032
1/22/04	50	3.4	2540	377	227.2328	0	34	20.4931	27.4	47.6	1237
3/18/04	1	3.4	2210	309	3.7249	0	30.5	0.3676	21.6	40.8	935
4/21/04		3.3	2000	277		0	25.1		20.6	38.9	1017
5/26/04		3.3	1960	288		0	28.4		20.1	44.1	944
Ave	19	3.311	2146.667	329.111	84.219	0	30.8	7.638	24.711	43.144	1153.111
Max	50	3.4	2540	408	227.233	0	40.5	20.493	28.4	47.6	1383
Min	1	3.2	1960	277	3.725	0	25.1	0.368	20.1	38.9	935
75% Conf	33.617	3.333	2220.069	344.794	151.538	0	32.62	13.691	25.882	44.112	1218.049
90% Conf	39.909	3.342	2251.665	351.545	180.515	0	33.403	16.296	26.385	44.528	1246.001

ER-8

Table 6: Water Chemistry for ER-8

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	5	3.7	1190	154	9.2821	0	0.38	0.0229	12.9	30.7	633
6/17/03	21.6	3.8	1020	125	32.5479	0	0.35	0.0911	12.6	25.1	556
8/28/03	9	3.7	1100	119	12.9106	0	1.17	0.1269	11.9	29.1	543
9/18/03	16.6	3.7	1350	181	36.2198	0	0.65	0.13	16	29.5	630
10/22/03	2	3.9	1330	142	3.4235	0	0.19	0.0045	13.2	27.8	561
11/18/03	50	3.8	889	82	49.4246	0	2.33	1.4043	8.59	20.5	395
1/22/04	4.5	4	1290	147	7.9742	0	0.21	0.0113	14	28.2	505
3/18/04	25	3.9	1290	166	50.0273	0	0.24	0.0723	15.7	29.7	528
4/21/04	26	3.8	1060	119	37.2975	0	0.6	0.188	12.3	30.1	510

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/26/04	9.93	3.7	1030	102	12.2098	0	1.03	0.1232	9.07	26.3	416
Ave	16.963	3.8	1154.9	133.7	25.132	0	0.715	0.217	12.626	27.7	527.7
Max	50	4	1350	181	50.027	0	2.33	1.404	16	30.7	633
Min	2	3.7	889	82	3.424	0	0.19	0.005	8.59	20.5	395
75% Conf	21.969	3.836	1209.204	144.065	31.292	0	0.943	0.363	13.461	28.759	554.575
90% Conf	24.123	3.852	1232.578	148.527	33.943	0	1.041	0.425	13.82	29.215	566.142

ER-9

Table 7: Water Chemistry for ER-9

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/17/03	11.25	3.1	2300	613	83.1328	0	5.06	0.6862	71.9	37.2	1592
7/23/03	6	2.9	2790	734	53.0893	0	11.5	0.8317	48.8	31.9	1758
8/28/03	7.5	2.9	2290	473	42.7643	0	6.29	0.5686	57.9	30.6	1185
9/18/03	10.7	3.1	2230	462	59.5916	0	3.53	0.4553	53.9	33.1	1187
10/22/03	6	3.1	2580	502	36.309	0	5.79	0.4187	62	38.8	1345
11/18/03	80	3.2	883	190	183.2328	0	7.65	7.3775	25.5	12.6	361
12/18/03	20	3.2	2490	425	102.4657	0	3.21	0.7739	61	36.4	1160
1/22/04	4	3.3	2310	394	18.9983	0	2.58	0.1244	51	34.7	1138
3/18/04	7.5	3.6	2130	380	34.3561	0	2.04	0.1844	50.6	33.2	981
4/21/04	7.5	3.2	2000	350	31.6438	0	2.46	0.2224	49.1	34.1	1112
5/26/04	18.75	3.2	2220	432	97.6438	0	2.74	0.6193	48.5	35	1247
Ave	16.291	3.164	2202.091	450.455	67.566	0	4.805	1.115	52.745	32.509	1187.818
Max	80	3.6	2790	734	183.233	0	11.5	7.378	71.9	38.8	1758
Min	4	2.9	883	190	18.998	0	2.04	0.124	25.5	12.6	361
75% Conf	23.481	3.227	2363.628	496.878	83.2	0	5.755	1.806	56.58	34.827	1304.801
90% Conf	26.576	3.254	2433.159	516.861	89.929	0	6.164	2.103	58.231	35.824	1355.155

ER-10

Table 8: Water Chemistry for ER-10

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	10	2.5	4440	1126	135.7369	0	57.1	6.8832	95.3	24.4	2269
7/23/03	5	2.6	4540	1148	69.1945	0	32.3	1.9468	108	33.4	2040
8/28/03	6	2.6	4220	804	58.1523	0	20.2	1.461	80.5	30.8	1944
9/18/03	1	2.8	2950	882	10.6323	0	22.9	0.276	93.1	33.5	1777
10/22/03	1	2.7	3200	918	11.0663	0	21.6	0.2603	95.3	34.8	1492
11/18/03	30	2.9	1130	296	107.0465	0	14.4	5.2076	33.9	9.85	368
12/18/03	5	3	2870	754	45.4465	0	20.5	1.2356	91.2	32.8	1303
1/22/04		3.1	2670	596		0	10.8		80.1	34.4	1328
3/18/04	1	2.9	2500	741	8.9326	0	19.2	0.2314	83.9	31.6	1212
4/21/04	2.5	2.8	2000	718	21.6383	0	19.7	0.5936	82.7	33.3	1413
5/26/04	7.14	2.8	2600	662	56.9791	0	11.4	0.9812	62.8	28.9	1370
Ave	6.864	2.791	3010.909	785.909	52.483	0	22.736	1.908	82.436	29.795	1501.455
Max	30	3.1	4540	1148	135.737	0	57.1	6.883	108	34.8	2269
Min	1	2.5	1130	296	8.933	0	10.8	0.231	33.9	9.85	368
75% Conf	9.852	2.851	3357.765	865.037	67.301	0	26.98	2.697	88.988	32.194	1670.485
90% Conf	11.138	2.877	3507.064	899.096	73.68	0	28.806	3.036	91.809	33.226	1743.242

ER-11

Table 9: Water Chemistry for ER-11

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/17/03	1.5	3	1910	621	11.229	0	14.8	0.2676	72.5	32.7	1262
8/28/03	1.5	3	2120	557	10.0717	0	14.8	0.2676	61.9	36.9	1134
9/18/03	1	3	2330	608	7.3293	0	12	0.1446	60.1	34.2	1153
10/22/03	1.5	3.1	2330	556	10.0536	0	13.7	0.2477	62.1	35.1	1140
11/18/03		3.1	1250	334		0	35.5		38.8	18.4	530
12/18/03	7.5	2.9	1820	614	55.5123	0	14.9	1.3471	79.4	14.5	632
3/18/04	6	3.7	1330	164	11.8619	0	1.16	0.0839	13.9	33.9	558
4/21/04	1	3.1	1780	391	4.7134	0	22	0.2652	53.2	31.8	917
5/26/04	1	3.1	1780	436	5.2558	0	7.8	0.094	41.6	28.7	878
Ave	2.625	3.111	1850	475.667	14.503	0	15.184	0.34	53.722	29.578	911.556
Max	7.5	3.7	2330	621	55.512	0	35.5	1.347	79.4	36.9	1262
Min	1	2.9	1250	164	4.713	0	1.16	0.084	13.9	14.5	530
75% Conf	3.609	3.195	1988.708	532.35	20.886	0	18.62	0.497	60.888	32.412	1013.191
90% Conf	4.033	3.231	2048.413	556.748	23.634	0	20.099	0.565	63.973	33.632	1056.938

ER-12

Table 10: Water Chemistry for ER-12

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
8/28/03	45	3.6	1120	116	62.926	0	2.52	1.367	10	26	538
9/18/03	67.5	3.6	1240	150	122.0547	0	2.34	1.904	11	24.8	526
11/18/03	200	3.1	624	190	458.0821	0	7.86	18.9501	23.7	4.3	193
12/18/03		3.9	1010	100		0	1.96		8.7	20.8	357
3/18/04	1	2.9	1320	469	5.6536	0	5.84	0.0704	60.2	11.4	454
4/21/04	5	2.7	1870	661	39.841	0	19	1.1452	79.8	17.4	784
5/26/04	1	2.8	1350	382	4.6049	0	12.1	0.1458	35.7	9.81	387
Ave	53.25	3.229	1219.143	295.429	115.527	0	7.374	3.93	32.729	16.359	462.714
Max	200	3.9	1870	661	458.082	0	19	18.95	79.8	26	784
Min	1	2.7	624	100	4.605	0	1.96	0.07	8.7	4.3	193
75% Conf	86.223	3.417	1371.416	381.411	189.823	0	9.91	7.099	43.903	19.636	536.666
90% Conf	100.415	3.498	1436.96	418.42	221.803	0	11.002	8.462	48.713	21.046	568.498

ER-13

Table 11: Water Chemistry for ER-13

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	154	3.6	989	112		0	1.69		8.06	21.4	544
6/17/03	114	3.7	888	96		0	1.29		8.15	18.1	431
7/23/03	27.5	3.4	1180	136	45.0849	0	2.1	0.6961	9.61	26.5	687
8/28/03	45	4.5	223	17	0.3073	5	5.21	0.0942	0.25	6.48	70
9/18/03	67.5	4.9	187	19	0.458	6	6.04	0.1456	0.26	4.32	58
10/22/03	72	3.7	1080	109	94.606	0	2.07	1.7966	8.44	21	436
11/18/03	133.8	3.6	738	62	100.0017	0	1.91	3.0806	5.93	14.6	326
12/18/03	275	4.8	131	10	1.2054	6	0.39	0.047	0.1	1.26	29
1/22/04	70	3.8	1240	126	106.3232	0	2.24	1.8901	9.77	22.4	438
3/18/04	114	3.8	1010	117		4	1.79		9.09	21.8	367

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
4/21/04	118	3.8	850	71		0	1.86		7.06	19.2	320
5/26/04	135	3.8	739	60	20.9319	0	1.6	0.5581	5.32	15.2	353
Ave	110.483	3.95	771.25	77.917	46.115	1.75	2.349	1.039	6.003	16.022	338.25
Max	275	4.9	1240	136	106.323	6	6.04	3.081	9.77	26.5	687
Min	27.5	3.4	131	10	0.307	0	0.39	0.047	0.1	1.26	29
75% Conf	131.11	4.107	894.736	92.158	64.135	2.587	2.862	1.457	7.193	18.558	401.799
90% Conf	139.989	4.175	947.889	98.289	71.892	2.947	3.083	1.638	7.705	19.65	429.153

ER-14

Table 12: Water Chemistry for ER-14

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/17/03	6.2	4.5	121	16	1.1958	4	0.23	0.0171	0.21	1.3	35
7/23/03	1.1	4	254	12	0.1591	0	2.27	0.0301	0.32	5.58	94
10/22/03		4.4	237	18		5	3.78		0.3	3.58	59
11/18/03	142.1	4.4	122	76	130.1869	4	3.99	6.8348	0.32	1.61	28
3/18/04	7.5	4.7	149	8	0.7232	0	0.72	0.065	0.17	1.56	36
4/21/04	13.75	4.6	100	8	1.326	3	0.36	0.0596	0.1	1.16	27
5/26/04	20	4.7	100	10	2.4109	6	1.05	0.2531	0.12	1.55	23
Ave	31.775	4.471	154.714	21.143	22.667	3.143	1.771	1.21	0.22	2.334	43.143
Max	142.1	4.7	254	76	130.187	6	3.99	6.835	0.32	5.58	94
Min	1.1	4	100	8	0.159	0	0.23	0.017	0.1	1.16	23
75% Conf	55.108	4.569	180.615	30.998	45.244	4.085	2.412	2.392	0.258	2.997	53.338
90% Conf	65.151	4.611	191.763	35.241	54.962	4.49	2.688	2.9	0.274	3.282	57.726

ER-15

Table 13: Water Chemistry for ER-15

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/17/03	2.5	2.6	2290	968	29.1726	0	32.8	0.9884	90.5	13.9	1160
7/23/03	1	2.6	2320	930	11.2109	0	33	0.3978	92	17.7	1215
10/22/03	2.5	2.7	2810	1097	33.0602	0	38.6	1.1632	128	23.4	1229
11/18/03	100	3.2	546	206	248.3287	0	2.89	3.4838	22.7	4.03	216
12/18/03	5	2.9	1850	601	36.2246	0	18.4	1.109	69.4	13.8	684
3/18/04	4.25	2.8	1720	606	31.0471	0	15.5	0.7941	68.7	13.5	615
4/21/04	2	2.7	1640	537	12.9468	0	28	0.675	68.4	16.5	652
5/26/04	11.42	2.7	1980	700	96.366	0	23.1	3.18	62.8	16.6	836
Ave	16.084	2.77	1894.5	705.625	62.295	0	24.036	1.474	75.313	14.929	825.875
Max	100	3.2	2810	1097	248.329	0	38.6	3.484	128	23.4	1229
Min	1	2.7	546	206	11.211	0	2.89	0.398	22.7	4.03	216
75% Conf	29.038	2.85	2147.54	814.28	92.592	0	28.438	1.921	86.755	17.001	961.675
90% Conf	34.615	2.89	2256.457	861.048	105.633	0	30.333	2.113	91.68	17.893	1020.128

ER-18

Table 14: Water Chemistry for ER-18

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/17/03	2.5	3.4	1220	508	15.3095	0	2.16	0.065	69	15.6	771
7/23/03	1	3.3	1480	512	6.172	0	2.73	0.0329	70.2	18.5	954
9/18/03	4.5	3.4	1360	447	24.2482	0	1.97	0.1068	57.5	16.5	687
10/22/03	3	3.5	1580	471	17.0334	0	1.6	0.0578	61.5	18.1	769
11/18/03	100	3.6	655	170	204.9315	0	2.02	2.435	21.3	7.51	311

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/18/04	1	3.6	1260	363	4.3758	0	0.59	0.0071	51.3	17.7	564
4/21/04	2.5	3.5	1120	306	9.2219	0	1.45	0.0436	43.3	16.5	565
Ave	16.357	3.471	1239.286	396.714	40.185	0	1.789	0.393	53.443	15.773	660.143
Max	100	3.6	1580	512	204.932	0	2.73	2.435	70.2	18.5	954
Min	1	3.3	655	170	4.376	0	0.59	0.007	21.3	7.51	311
75% Conf	31.207	3.516	1360.571	447.214	69.549	0	2.058	0.755	60.305	17.296	742.517
90% Conf	37.599	3.535	1412.776	468.95	82.189	0	2.175	0.911	63.259	17.951	777.973

ER-21

Table 15: Water Chemistry for ER-21

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	83.8	5	77	8	8.0815	4	0.07	0.0707	0.16	0.13	33
6/17/03	35.1	4.9	81	19	8.0393	6	0.04	0.0169	0.15	0.12	20
8/28/03	5.5	4.9	88	12	0.7956	6	0.21	0.0139	0.27	0.2	28
11/18/03	40	3.7	230	34	16.3945	0	0.96	0.4629	2.82	2.17	60
12/18/03	20	5	96	7	1.6876	7	0.26	0.0626	0.16	0.16	21
1/22/04	12	5	136	25	3.6164	6	0.08	0.0115	0.29	0.22	34
3/18/04	10	4.9	107	7	0.8438	5	0.1	0.012	0.25	0.14	21
Ave	29.486	4.771	116.429	16	5.637	4.857	0.246	0.093	0.586	0.449	31
Max	83.8	5	230	34	16.395	7	0.96	0.463	2.82	2.17	60
Min	5.5	3.7	77	7	0.796	0	0.04	0.012	0.15	0.12	20
75% Conf	40.436	4.963	138.103	20.208	7.923	5.799	0.376	0.159	0.983	0.754	36.653
90% Conf	45.15	5.045	147.432	22.019	8.906	6.204	0.433	0.188	1.154	0.886	39.086

ER-25

Table 16: Water Chemistry for ER-25

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/17/03		3.6	791	119		0	2.43		12.1	13.6	381
7/23/03	2.5	3.3	1070	174	5.2438	0	5.46	0.1645	15.1	17.74	615
8/28/03		3.3	1050	152		0	5.44		15	18.9	482
9/18/03		3.4	1230	192		0	4.39		16.6	21.9	495
10/22/03		3.5	1010	144		0	3.72		12.1	15.7	383
11/18/03		3.5	446	68		0	12.1		8.55	6.21	158
12/18/03		3.7	860	111		0	3.42		12.4	15	288
1/22/04		3.7	1150	155		0	4.46		14.9	19.3	425
3/18/04		3.7	906	127		0	3.79		11.7	16.5	302
4/21/04		3.5	840	98		0	4.28		10.9	16.5	302
5/26/04	9.24	3.5	754	94	10.4703	0	2.96	0.3297	8.99	12.6	328
Ave	5.87	3.518	918.818	130.364	7.857	0	4.768	0.247	12.576	15.814	378.091
Max	9.24	3.7	1230	192	10.47	0	12.1	0.33	16.6	21.9	615
Min	2.5	3.3	446	68	5.244	0	2.43	0.165	8.55	6.21	158
75% Conf	8.61	3.567	990.913	142.618	9.982	0	5.629	0.314	13.432	17.183	419.047
90% Conf	9.79	3.588	1021.945	147.892	10.897	0	5.999	0.343	13.8	17.772	436.676

ER-28

Table 17: Water Chemistry for ER-28

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	4.41	4.7	108	6	0.3189	6	0.24	0.0127	0.17	0.28	42
8/28/03	1.5	4.9	82	12	0.2169	7	0.92	0.0166	0.2	0.57	27
9/18/03	3	5.1	92	15	0.5424	6	1.76	0.0636	0.33	0.46	23
10/22/03	3	4.8	137	14	0.5063	7	0.4	0.0144	0.14	0.51	33
11/18/03	6	4.6	86	12	0.8679	6	0.79	0.0571	0.39	0.38	18
12/18/03	3	4.9	113	9	0.3254	6	0.68	0.0245	0.17	0.63	26
1/22/04		3.5	1130	148		0	4.94		15.5	20.9	393
3/18/04	3	4.9	119	7	0.2531	5	7.2	0.2603	2.05	0.68	27
4/21/04	1	4.8	100	7	0.0843	4	0.33	0.0039	0.14	0.29	29
5/26/04	6.42	4.6	105	8	0.6191	6	0.56	0.0433	0.17	0.54	24
Ave	3.481	4.68	207.2	23.8	0.415	5.3	1.782	0.055	1.926	2.524	64.2
Max	6.42	5.1	1130	148	0.868	7	7.2	0.26	15.5	20.9	393
Min	1	3.5	82	6	0.084	0	0.24	0.004	0.14	0.28	18
75% Conf	4.143	4.832	319.203	38.894	0.502	6.01	2.596	0.084	3.584	4.752	104.118
90% Conf	4.428	4.898	367.413	45.391	0.539	6.315	2.947	0.096	4.297	5.711	121.301

ER-29

Table 18: Water Chemistry for ER-29

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	6.67	4.4	255	10	0.804	4	0.48	0.0385	0.58	0.57	97
8/28/03	2	4.3	251	16	0.3857	4	18	0.4339	3.27	1.53	90
9/18/03	2	4.6	281	20	0.4821	5	7.32	0.1764	1	1.52	95
10/22/03	2	4.4	309	19	0.458	5	7.29	0.1757	1.32	1.42	104
11/18/03	4	4.5	203	10	0.4821	6	0.25	0.012	0.52	0.81	60
12/18/03	9	4.6	272	12	1.3019	6	0.46	0.0499	0.63	0.91	82
1/22/04	2.5	4.4	283	10	0.3013	4	2.04	0.0614	0.87	0.91	89
3/18/04	12	4.5	262	12	1.7358	4	0.35	0.0506	0.57	0.77	80
4/21/04	1.5	4.4	270	10	0.1808	3	2.21	0.0399	0.75	0.75	86
5/26/04	10	4.3	240	14	1.6876	2	0.42	0.0506	0.47	1.76	76
Ave	5.167	4.44	262.6	13.3	0.782	4.3	3.882	0.109	0.998	1.095	85.9
Max	12	4.6	309	20	1.736	6	18	0.434	3.27	1.76	104
Min	1.5	4.3	203	10	0.181	2	0.25	0.012	0.47	0.57	60
75% Conf	6.523	4.477	272.43	14.622	0.982	4.732	5.84	0.153	1.288	1.239	90.17
90% Conf	7.106	4.493	276.661	15.191	1.069	4.918	6.683	0.172	1.412	1.301	92.008

ER-30

Table 19: Water Chemistry for ER-30

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	3.1	4.7	539	76	2.8401	6	68.7	2.5673	3.29	6.4	233
6/17/03	1.5	5.6	679	120	2.1698	9	53.2	0.9619	2.05	7	365
7/23/03	1	5.4	743	116	1.3983	12	55.9	0.6738	0.21	7.96	387
8/28/03	2	4.6	619	94	2.2663	6	50.5	1.2175	0.83	7.33	289
9/18/03	3	5.5	1460	254	9.1857	20	131	4.7375	0.32	17.2	648
Ave	2.12	5.16	808	132	3.572	10.6	71.86	2.032	1.34	9.178	384.4
Max	3.1	5.6	1460	254	9.186	20	131	4.738	3.29	17.2	648
Min	1	4.6	539	76	1.398	6	50.5	0.674	0.21	6.4	233
75% Conf	2.543	5.377	979.2	164.416	5.035	13.274	87.403	2.803	1.943	11.257	457.817
90% Conf	2.726	5.471	1052.89	178.369	5.664	14.425	94.093	3.136	2.203	12.152	489.418

ER-31

Table 20: Water Chemistry for ER-31

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	12.7	3.3	596	64	9.7981	0	14	2.1433	0.11	4.06	177
6/17/03	2.5	5.3	141	12	0.3616	6	2.55	0.0768	0.56	0.15	52
7/23/03	2.5	5	196	4	0.1205	8	0.36	0.0108	0.2	0.23	78
8/28/03	2.2	3.1	1030	117	3.1029	0	26.3	0.6974	0.1	9.39	406
9/18/03	2.2	3.2	908	105	2.7846	0	24.7	0.655	0.09	7.86	278
10/22/03	6.2	3.3	684	65	4.858	0	12	0.8968	0.11	4.63	228
11/18/03	35.1	3.3	349	30	12.6936	0	7.05	2.983	0.17	1.88	93
12/18/03	12.7	3.9	463	43	6.5831	0	15.5	2.3729	0.11	3.35	140
1/22/04	2.2	3.5	792	76	2.0155	0	23.1	0.6126	0.16	6.66	232
3/18/04	12.7	3.7	517	51	7.8078	0	17.9	2.7404	0.11	4.08	172
4/21/04	12.7	3.5	470	39	5.9707	0	12.5	1.9136	0.1	3.56	157
5/26/04	12	3.4	455	48	6.9435	0	10.3	1.4899	0.09	3.4	141
Ave	9.642	3.708	550.083	54.5	5.253	1.167	13.855	1.383	0.159	4.104	179.5
Max	35.1	5.3	1030	117	12.694	8	26.3	2.983	0.56	9.39	406
Min	2.2	3.1	141	4	0.121	0	0.36	0.011	0.09	0.15	52
75% Conf	12.628	3.934	635.492	65.216	6.463	2.043	16.482	1.71	0.201	4.992	210.37
90% Conf	13.913	4.031	672.255	69.828	6.984	2.421	17.612	1.851	0.219	5.374	223.658

ER-32

Table 21: Water Chemistry for ER-32

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	3.21	3.5	428	36	1.393	0	141	5.4561	2.23	4.59	124
6/17/03	1.275	3.6	340	35	0.5379	0	124	1.9058	1.29	3.61	96
7/23/03		3.4	489	46		0	2.26		1.2	5.44	156
8/28/03	1.5	3.4	460	48	0.8679	0	2.32	0.0419	1.01	5.31	125
9/18/03	4	3.5	450	49	2.3627	0	2.17	0.1046	0.81	4.82	119
10/22/03	6	3.5	431	44	3.1824	0	2.52	0.1822	0.77	4.78	122
11/18/03	12	3.5	324	36	5.2076	0	25.2	3.6453	1.59	3.51	87
12/18/03	7.5	3.8	373	28	2.5315	0	4.7	0.4249	1	4.48	91
3/18/04	6	3.7	362	25	1.8082	0	2.06	0.1489	0.75	3.86	93
4/21/04	6	3.5	400	25	1.8082	0	4.08	0.2951	0.64	4.07	104
5/26/04	8.57	3.4	365	32	3.3059	0	1.45	0.1497	0.52	4.51	88
Ave	5.606	3.527	402	36.727	2.301	0	28.342	1.235	1.074	4.453	109.545
Max	12	3.8	489	49	5.208	0	141	5.456	2.23	5.44	156
Min	1.275	3.4	324	25	0.538	0	1.45	0.042	0.52	3.51	87
75% Conf	6.742	3.569	419.648	39.673	2.771	0	45.559	1.884	1.237	4.664	116.678
90% Conf	7.231	3.587	427.244	40.942	2.974	0	52.97	2.163	1.307	4.754	119.748

ER-33

Table 22: Water Chemistry for ER-33

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03		3.5	676	92		0	4.22		8.75	40.5	257
6/19/03		3.6	700	94		0	3.57		10.6	12.6	338
7/23/03		3.3	937	144		0	6.42		12.6	14.7	492
8/28/03		3.4	922	132		0	6.29		15.5	15.4	406
9/18/03		3.4	1130	171		0	8.77		15.8	21	424
10/22/03		3.4	931	124		0	14.4		13.6	15	324
11/18/03		3.5	459	64		0	7.77		6.94	6.21	170
12/18/03		3.7	780	102		0	4.62		11.8	13.4	308
1/22/04		3.6	1070	138		0	5.67		14.3	19.1	375

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/18/04		3.6	783	107		0	4.76		9.02	11.7	329
5/26/04		3.4	702	86		0	4.05		7.95	11.7	294
Ave		3.491	826.364	114		0	6.413		11.533	16.483	337.909
Max		3.7	1130	171		0	14.4		15.8	40.5	492
Min		3.3	459	64		0	3.57		6.94	6.21	170
75% Conf		3.531	890.548	124.195		0	7.438		12.557	19.415	366.541
90% Conf		3.549	918.175	128.584		0	7.879		12.998	20.677	378.865

ER-34

Table 23: Water Chemistry for ER-34

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	3.15	3.3	766	88	3.3415	0	2.59	0.0983	6.04	9.87	268
6/17/03	3	3.3	644	73	2.64	0	6.17	0.2231	5.03	7.82	248
7/23/03	3	3.2	713	72	2.6038	0	4.28	0.1547	3.35	7.29	260
8/28/03	2	3.2	726	78	1.8805	0	10.6	0.2555	4.35	8.78	235
9/18/03	1.5	3.3	716	84	1.5189	0	16.2	0.2929	6.35	7.32	244
10/22/03	3	3.4	779	76	2.7484	0	2.22	0.0802	4.08	7.83	257
11/18/03	6	3.3	528	58	4.195	0	1.1	0.0795	2.86	6.11	172
12/18/03	3	3.6	669	67	2.423	0	1.64	0.0593	5.92	8.6	224
3/18/04	2	3.5	621	68	1.6394	0	1.15	0.0277	4.56	6.39	222
4/21/04	3	3.4	630	53	1.9167	0	2.42	0.0875	4.74	7.18	231
Ave	2.965	3.35	679.2	71.7	2.491	0	4.837	0.136	4.728	7.719	236.1
Max	6	3.6	779	88	4.195	0	16.2	0.293	6.35	9.87	268
Min	1.5	3.2	528	53	1.519	0	1.1	0.028	2.86	6.11	172
75% Conf	3.384	3.394	705.473	75.427	2.775	0	6.542	0.167	5.124	8.11	245.521
90% Conf	3.564	3.413	716.782	77.031	2.897	0	7.277	0.181	5.294	8.278	249.576

ER-35

Table 24: Water Chemistry for ER-35

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	6	4.5	1410	188	13.5978	6	95.9	6.9363	0.12	17.7	833
6/19/03	13.7	4.2	1370	207	34.1861	3	96.2	15.8874	0.09	16.9	877
7/23/03		4.8	1400	186		10	102		0.03	17.8	918
8/28/03	15	3.3	1490	188	33.9945	0	95.6	17.2865	0.05	18.4	716
9/18/03	15	3.4	1550	201	36.3452	0	85.5	15.4602	0.06	17.5	714
10/22/03	24	3.1	1690	183	52.9446	0	85.3	24.6785	0.05	17.2	701
11/18/03	24	3.1	713	54	15.623	0	21.5	6.2202	0.55	6.63	254
12/18/03	13	3.9	1510	187	29.3052	0	91.5	14.3391	0.11	17.3	654
1/22/04	1.5	5.9	1520	200	3.6164	14	90.4	1.6346	0.05	17	680
3/18/04	15	4.4	1410	212	38.3342	4	96.8	17.5035	0.05	17.4	595
4/21/04	20	4.9	1410	174	41.9506	6	105	25.315	0.05	19.1	639
5/26/04		4.7	1360	206		8	101		0.06	17.8	633
Ave	14.72	4.183	1402.75	182.167	29.99	4.25	88.892	14.526	0.106	16.728	684.5
Max	24	5.9	1690	212	52.945	14	105	25.315	0.55	19.1	918
Min	1.5	3.1	713	54	3.616	0	21.5	1.635	0.03	6.63	254
75% Conf	17.173	4.456	1477.958	195.497	35.113	5.735	95.91	17.177	0.151	17.757	738.267
90% Conf	18.23	4.573	1510.33	201.234	37.318	6.375	98.931	18.319	0.171	18.2	761.411

ER-36

Table 25: Water Chemistry for ER-36

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	1.875	3.4	677	54	1.2205	0	7.75	0.1751	0.04	4.14	231
6/19/03	3	4.4	1700	213	7.703	5	108	3.9057	0.03	19.2	886
7/23/03	2	3	1260	116	2.7967	0	14.9	0.3592	0.05	9.47	562
8/28/03	1	3.5	1580	217	2.6158	0	37.3	0.4496	0.06	18	887
9/18/03	1	3.1	1690	198	2.3868	0	58.6	0.7064	0.05	16.3	647
10/22/03	2	3	1870	200	4.8219	0	55.9	1.3477	0.27	18.1	768
11/18/03	4	3.3	514	34	1.6394	0	23.9	1.1524	0.08	3.26	168
12/18/03	1	3.6	1780	213	2.5676	0	175	2.1095	0.1	18.7	745
1/22/04	0.5	5.3	1630	212	1.2778	8	126	0.7594	0.05	18.9	745
3/18/04	3.5	3.3	1640	218	9.1978	0	94.3	3.9786	0.05	18.1	686
4/21/04	3	4.6	1520	188	6.7989	5	79	2.8569	0.16	21.7	757
5/26/04	20	5	1510	214	51.5945	8	104	25.0739	0.05	18.3	713
Ave	3.573	3.792	1447.583	173.083	7.885	2.167	73.721	3.573	0.083	15.348	649.583
Max	20	5.3	1870	218	51.595	8	175	25.074	0.27	21.7	887
Min	0.5	3	514	34	1.221	0	7.75	0.175	0.03	3.26	168
75% Conf	5.254	4.05	1583.415	194.226	12.341	3.224	89.671	5.766	0.104	17.305	722.328
90% Conf	5.978	4.161	1641.882	203.327	14.259	3.679	96.536	6.71	0.114	18.147	753.639

ER-38

Table 26: Water Chemistry for ER-38

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	15	3.9	307	18	3.2547	0	0.72	0.1301	0.15	1.74	109
6/19/03	2	3.9	319	23	0.5545	0	3.19	0.0769	0.23	2.61	130
7/23/03	1.5	3.7	440	22	0.3978	0	2.17	0.0392	0.32	3.69	162
8/28/03	1.5	3.7	445	31	0.5605	0	1.88	0.0339	0.18	4.2	163
9/18/03	2	3.7	733	48	1.1572	0	3.66	0.0882	0.31	8.33	316
10/22/03	3	3.8	570	32	1.1572	0	2.3	0.0831	0.33	5.73	184
11/18/03	6	4.1	206	14	1.0126	2	1.72	0.1244	0.44	1.52	57
12/18/03	3	4.1	391	20	0.7232	2	5.32	0.1923	0.55	3.87	118
3/18/04	2.5	3.9	467	17	0.5123	0	1.32	0.0397	0.41	3.7	153
4/21/04	3	3.8	430	20	0.7232	0	2.62	0.0947	0.37	4.06	181
5/26/04	15	3.8	353	22	3.978	0	1.78	0.3218	0.24	3.69	109
Ave	4.955	3.855	423.727	24.273	1.276	0.364	2.425	0.111	0.321	3.922	152.909
Max	15	4.1	733	48	3.978	2	5.32	0.322	0.55	8.33	316
Min	1.5	3.7	206	14	0.398	0	0.72	0.034	0.15	1.52	57
75% Conf	6.646	3.902	470.217	27.434	1.671	0.631	2.843	0.139	0.36	4.542	174.673
90% Conf	7.374	3.923	490.228	28.794	1.841	0.746	3.023	0.151	0.377	4.809	184.041

ER-39

Table 27: Water Chemistry for ER-39

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	200	4.5	407	28	67.5068	6	0.17	0.4098	2.79	2.92	149
6/19/03	12.7	4.6	413	36	5.5114	6	2.32	0.3551	5.08	3.48	175
7/23/03		4.6	455	18		8	0.33		2	4.17	192
8/28/03	96.6	4.7	500	28	32.6058	6	0.53	0.6171	2.84	5.01	212
9/18/03	291.6	4.4	605	58	203.8803	5	0.3	1.0545	6.51	5.13	258
10/22/03	291.6	4.6	488	38	133.5767	7	0.38	1.3357	3.63	3.73	177
11/18/03	550	4.8	261	10	66.3013	8	6.72	44.5545	2.94	1.63	81
12/18/03	546	4.5	522	46	302.7682	6	0.27	1.7771	5.55	3.72	184
1/22/04	35.1	4.3	564	42	17.7711	4	0.86	0.3638	6.15	4.57	210

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/18/04	198.4	4.4	524	42	100.4501	4	0.23	0.55	5.31	3.62	175
4/21/04	198.4	4.3	480	36	86.1001	3	0.2	0.4783	4.71	3.43	175
5/26/04	198.4	4.6	350	22	52.6167	6	0.31	0.7414	2.26	2.59	112
Ave	238.073	4.525	464.083	33.667	97.19	5.75	1.052	4.749	4.148	3.667	175
Max	550	4.8	605	58	302.768	8	6.72	44.555	6.51	5.13	258
Min	12.7	4.3	261	10	5.511	3	0.17	0.355	2	1.63	81
75% Conf	296.844	4.574	494.253	37.864	126.352	6.241	1.65	9.116	4.65	3.984	189.64
90% Conf	322.141	4.595	507.239	39.671	138.904	6.452	1.907	10.996	4.867	4.121	195.942

ER-40

Table 28: Water Chemistry for ER-40

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	5	3.3	1600	138	8.3178	0	37.5	2.2602	0.19	11.9	774
6/19/03	2	3.2	1510	158	3.8093	0	66.4	1.6008	0.1	14.4	845
10/22/03	1.5	3.1	1740	160	2.8931	0	53.4	0.9655	0.84	14.3	746
11/18/03	35.1	3.1	1060	94	39.7735	0	22.9	9.6895	0.05	7.6	427
12/18/03	1.5	3.5	1670	114	2.0613	0	47.1	0.8516	0.24	11.8	634
1/22/04	3	3.3	1650	152	5.4969	0	283	10.2345	0.16	15.1	645
3/18/04	3	3.1	1650	144	5.2076	0	147	5.3161	0.14	14.3	619
4/21/04	5	3.1	1780	141	8.4986	0	147	8.8602	0.22	15.5	695
Ave	7.013	3.213	1582.5	137.625	9.507	0	100.538	4.972	0.242	13.112	673.125
Max	35.1	3.5	1780	160	39.774	0	283	10.235	0.84	15.5	845
Min	1.5	3.1	1060	94	2.061	0	22.9	0.852	0.05	7.6	427
75% Conf	11.361	3.268	1668.648	146.293	14.242	0	133.897	6.527	0.337	14.105	721.09
90% Conf	13.233	3.292	1705.729	150.024	16.279	0	148.256	7.196	0.378	14.533	741.736

ER-41

Table 29: Water Chemistry for ER-41

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	17.3	4.1	336	16	3.3367	2	1.14	0.2377	0.39	3.06	119
6/19/03	3	3.8	355	27	0.9764	0	1.96	0.0708	0.48	3.76	136
8/28/03	2.5	3.3	842	72	2.1698	0	7.66	0.2308	2.11	8.65	333
9/18/03	3	3.8	482	54	1.9528	0	24.4	0.8824	0.22	5.15	183
10/22/03	6	4.2	466	35	2.5315	4	9.99	0.7225	0.29	5.91	152
11/18/03	12	4	276	14	2.0252	0	3.76	0.5439	0.24	4.08	86
3/18/04	6	4	369	16	1.1572	0	6.21	0.4491	0.41	4.11	113
4/21/04	7	3.8	280	16	1.3501	0	14	1.1813	0.3	4.01	126
Ave	7.1	3.875	425.75	31.25	1.937	0.75	8.64	0.54	0.555	4.841	156
Max	17.3	4.2	842	72	3.337	4	24.4	1.181	2.11	8.65	333
Min	2.5	3.3	276	14	0.976	0	1.14	0.071	0.22	3.06	86
75% Conf	9.057	3.98	495.878	39.389	2.234	1.316	11.552	0.682	0.796	5.514	185.281
90% Conf	9.899	4.025	526.064	42.892	2.361	1.56	12.806	0.743	0.9	5.803	197.885

ER-43

Table 30: Water Chemistry for ER-43

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03		3.6	680	88		0	5.51		6.41	8.79	253
6/19/03		3.5	661	80		0	6.99		6.65	8.63	317
7/23/03		3.3	900	106		0	9.78		7.77	11.9	443
8/28/03		3.5	464	41		0	20.4		0.36	5.5	155
9/18/03		3.4	1070	140		0	8		10.2	15.6	428
10/22/03		3.4	899	103		0	9.97		7.27	11.2	328
11/18/03		3.7	421	44		0	12.5		4.42	4.7	146
12/18/03	5	3.8	743	83	5.0027	0	5.69	0.3429	7.77	10.4	278
1/22/04	1	3.6	967	118	1.4224	0	8.95	0.1078	9.4	13.5	325
3/18/04		3.7	784	86		0	7.32		7.31	10.5	335
4/21/04		3.5	770	74		0	4.8		6.66	10.3	253
5/26/04		3.5	682	80		0	8.74		6.62	9.93	286
Ave	3	3.542	753.417	86.917	3.213	0	9.054	0.225	6.737	10.079	295.583
Max	5	3.8	1070	140	5.003	0	20.4	0.343	10.2	15.6	443
Min	1	3.3	421	41	1.422	0	4.8	0.108	0.36	4.7	146
75% Conf	4.626	3.588	814.264	95.823	4.668	0	10.384	0.321	7.527	11.041	324.231
90% Conf	5.326	3.607	840.455	99.657	5.295	0	10.956	0.362	7.867	11.455	336.562

ER-44

Table 31: Water Chemistry for ER-44

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/14/03	300	3.6	714	84	303.7808	0	3.25	11.7534	6.47	8.98	261
6/19/03	200	3.3	922	98	236.2739	0	6.08	14.6586	6.03	10.6	477
7/23/03		2.8	4670	322		0	54.6		0.72	30.2	2517
8/28/03		3.2	977	112		0	5.26		6.93	12.3	390
9/18/03		3.3	1140	140		0	7.14		8.93	14.5	423
10/22/03		3.4	977	104		0	3.49		6.57	11.7	333
11/18/03		3.6	435	48		0	43.8		7.47	5.18	151
12/18/03		3.7	763	84		0	4.28		6.61	9.11	293
1/22/04		3.5	984	104		0	12.4		10.1	13.5	308
3/18/04		3.6	805	91		0	3.71		6.79	10.3	287
4/21/04		3.1	780	90		0	8.98		0.75	11.9	512
5/26/04		3.4	2020	146		0	91.6		0.27	21.3	1100
Ave	250	3.375	1265.583	118.583	270.027	0	20.382	13.206	5.637	13.298	587.667
Max	300	3.7	4670	322	303.781	0	91.6	14.659	10.1	30.2	2517
Min	200	2.8	435	48	236.274	0	3.25	11.753	0.27	5.18	151
75% Conf	290.659	3.456	1627.137	140.527	297.475	0	29.326	14.387	6.672	15.386	795.133
90% Conf	308.16	3.492	1782.762	149.973	309.289	0	33.176	14.896	7.117	16.285	884.434

ER-45

Table 32: Water Chemistry for ER-45

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/14/03	50	3.4	1910	160	96.4383	0	44.1	26.5808	0.27	16.9	1235
6/19/03	15	3.2	1780	143	25.8575	0	50.1	9.0591	0.32	18.9	1021
8/28/03		3	1870	146		0	59.4		0.54	18.7	960
9/18/03		3.2	2080	179		0	55.2		0.41	18.4	961
10/22/03		3.2	1920	141		0	45.2		0.09	16.4	896
11/18/03		3.2	1110	80		0	34.9		0.48	10.2	504
12/18/03		3.5	1810	117		0	58.8		0.17	18.6	735

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
1/22/04		3.7	1940	138		0	64.8		0.12	17.2	881
3/18/04		3.2	2050	140		0	438		1.17	17.9	936
4/21/04		3.3	580	92		0	41.6		0.16	14.9	642
5/26/04	25	3.2	1460	100	30.1369	0	34.3	10.3369	0.15	14.7	600
Ave	30	3.28	1682.727	130.545	50.811	0	84.218	15.326	0.353	16.618	851.909
Max	50	3.7	2080	179	96.438	0	438	26.581	1.17	18.9	1235
Min	15	3.0	580	80	25.858	0	34.3	9.059	0.09	10.2	504
75% Conf	39.773	3.34	1834.991	140.475	72.264	0	123.151	20.621	0.455	17.471	922.12
90% Conf	43.98	3.37	1900.531	144.749	81.498	0	139.908	22.9	0.5	17.838	952.341

ER-46

Table 33: Water Chemistry for ER-46

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/14/03	3	4.7	73	6	0.2169	6	0.4	0.0144	0.11	0.61	28
6/19/03	7.6	4.7	91	15	1.3742	5	0.47	0.043	0.14	0.64	19
7/23/03	0.4	4.7	91	8	0.0385	10	5.6	0.027	0.16	1.87	34
8/28/03	1	5	124	17	0.2049	8	37.2	0.4484	0.45	3.26	37
9/18/03	5	4.5	230	28	1.6876	5	66.4	4.0021	3.72	55.4	64
10/22/03		5.4	128	14		10	10.4		0.28	1.91	25
11/18/03	3	3.8	342	34	1.2295	0	8.71	0.3149	3.1	4.42	107
12/18/03	10	4	239	21	2.5315	1	39.8	4.7978	4.25	4.25	57
3/18/04		4.5	96	7		4	2.61		0.49	1.23	20
4/21/04	3	4.6	70	8	0.2893	3	0.92	0.0332	0.1	0.1	17
Ave	4.125	4.59	148.4	15.8	0.947	5.2	17.251	1.21	1.28	7.369	40.8
Max	10	5.4	342	34	2.532	10	66.4	4.798	4.25	55.4	107
Min	0.4	3.8	70	6	0.039	0	0.4	0.014	0.1	0.1	17
75% Conf	5.368	4.746	179.794	19.068	1.289	6.382	25.071	1.966	1.863	13.215	50.512
90% Conf	5.903	4.814	193.308	20.475	1.436	6.89	28.437	2.291	2.114	15.731	54.692

ER-48

Table 34: Water Chemistry for ER-48

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/14/03	14.8	3.8	385	56	9.991	0	0.12	0.0214	6.37	1.59	132
6/19/03	14.8	3.7	372	60	10.7046	0	0.15	0.0267	7.41	1.82	136
7/23/03	1.6	3.7	388	54	1.0415	0	1.47	0.0283	6.28	1.79	146
8/28/03	5	3.7	392	62	3.7369	0	2.77	0.1669	6.37	1.73	133
9/18/03	12	3.7	421	64	9.258	0	7.83	1.1326	8.83	1.64	144
10/22/03		3.8	398	56		0	1.22		5.43	1.45	120
11/18/03	30	3.7	281	40	14.4657	0	0.48	0.1735	4.11	1.23	99
12/18/03	27	3.9	399	50	16.2739	0	0.57	0.1855	6.05	1.81	116
1/22/04		3.6	480	58		0	0.32		7.43	1.99	157
3/18/04	30	3.8	386	49	17.7205	0	0.12	0.0433	5.78	1.65	121
4/21/04	2	3.7	380	43	1.0367	0	0.39	0.0094	4.66	1.49	122
5/26/04	12.7	3.8	350	38	5.8176	0	0.35	0.0535	4.03	1.43	105
Ave	14.99	3.742	386	52.5	9.005	0	1.316	0.184	6.063	1.635	127.583
Max	30	3.9	480	64	17.721	0	7.83	1.133	8.83	1.99	157
Min	1.6	3.6	281	38	1.037	0	0.12	0.009	4.03	1.23	99
75% Conf	18.729	3.767	400.524	55.229	11.085	0	2.012	0.302	6.512	1.702	132.993
90% Conf	20.338	3.778	406.775	56.404	11.981	0	2.312	0.352	6.705	1.731	135.322

ER-49

Table 35: Water Chemistry for ER-49

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/14/03	150.7	6.3	119	0	0	12	0.14	0.2543	0.08	0.1	28
6/19/03	7	6.1	145	2	0.1687	15	0.25	0.021	0.11	0.15	20
7/23/03		6.5	171	0		22	0.52		0.15	0.48	31
8/28/03	130	6.5	160	0	0	22	2.83	4.4349	0.69	0.74	23
9/18/03		6.1	161	0		21	1.99		0.38	0.5	19
10/22/03		6.2	132	4		18	0.73		0.08	0.23	18
11/18/03	60	6.2	102	0	0	12	2.19	1.5839	0.8	0.6	19
12/18/03	100	6.2	140	2	2.4109	13	0.32	0.3857	0.09	0.15	17
1/22/04		6.2	149	0		14	29.5		7.79	5.32	20
3/18/04	10	6.1	161	1	0.1205	10	0.66	0.0795	0.27	0.2	18
4/21/04	23	6.8	160	0	0	11	0.52	0.1441	0.12	0.12	18
Ave	68.671	6.291	145.455	0.818	0.386	15.455	3.605	0.986	0.96	0.781	21
Max	150.7	6.8	171	4	2.411	22	29.5	4.435	7.79	5.32	31
Min	7	6.1	102	0	0	10	0.14	0.021	0.08	0.1	17
75% Conf	92.41	6.364	152.366	1.257	0.746	16.95	6.46	1.635	1.714	1.284	22.501
90% Conf	102.627	6.395	155.341	1.446	0.901	17.594	7.689	1.915	2.038	1.5	23.146

ER-50

Table 36: Water Chemistry for ER-50

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/14/03	7.6	5.3	155	6	0.5496	8	6.07	0.5561	0.07	1.59	40
6/19/03	1.1	5.7	128	7	0.0928	13	3.08	0.0408	0.12	1.17	26
7/23/03	1.1	5.6	104	2	0.0265	10	0.71	0.0094	0.31	0.44	29
8/28/03	3	3.3	845	96	3.4717	0	8.39	0.3034	2.7	5.01	350
9/18/03	1	6	154	0	0	25	15.3	0.1844	0.54	3.03	23
10/22/03		5.8	165	7		16	7.84		0.47	2.71	27
11/18/03	1.5	5.5	116	2	0.0361	10	2.77	0.05	1.22	1.07	23
12/18/03	3	3.8	669	69	2.4953	0	7.86	0.2842	6.9	9.53	251
3/18/04	3	3.6	797	63	2.2783	0	16.6	0.6003	6.41	8.7	254
4/21/04	0	5.7	150	4	0	7	2.01	0	0.12	1.12	30
Ave	2.367	5.03	328.3	25.6	0.994	8.9	7.063	0.225	1.886	3.437	105.3
Max	7.6	6	845	96	3.472	25	16.6	0.6	6.9	9.53	350
Min	0	3.3	104	0	0	0	0.71	0	0.07	0.44	23
75% Conf	3.175	5.386	434.767	37.959	1.487	11.648	8.928	0.309	2.796	4.567	149.082
90% Conf	3.523	5.54	480.594	43.279	1.7	12.83	9.731	0.344	3.187	5.053	167.927

ER-53

Table 37: Water Chemistry for ER-53

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/14/03		6.8	306	0		16	0.21		0.06	0.4	97
6/19/03	75	6.2	298	0	0	18	0.34	0.3073	0.11	0.41	98
7/23/03		6.6	300	0		22	0.3		0.08	0.83	98
8/28/03		6.4	250	0		20	20.9		7.18	3.95	69
9/18/03	1	6.1	378	0	0	21	1	0.012	0.32	0.65	111
10/22/03		6.2	367	0		22	0.37		0.15	0.84	94
11/18/03	15	6.5	155	0	0	16	6.03	1.0903	2.51	0.77	34
12/18/03	20	6.3	364	0	0	18	0.19	0.0458	0.05	0.23	100
1/22/04		6.7	422	0		20	0.48		0.14	0.48	120
3/18/04	15	6.3	351	0	0	16	0.28	0.0506	0.1	0.29	103
4/21/04	2	6.6	320	0	0	19	0.52	0.0125	0.13	0.28	105

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/26/04	150	7.1	294	0	0	26	0.69	1.2476	0.17	0.65	72
Ave	39.714	6.483	317.083	0	0	19.5	2.609	0.395	0.917	0.815	91.75
Max	150	7.1	422	0	0	26	20.9	1.248	7.18	3.95	120
Min	1	6.1	155	0	0	16	0.19	0.012	0.05	0.23	34
75% Conf	61.718	6.576	339.073	0	0	20.454	4.511	0.613	1.581	1.136	99.106
90% Conf	71.19	6.616	348.539	0	0	20.864	5.33	0.706	1.866	1.275	102.273

ER-54

Table 38: Water Chemistry for ER-54

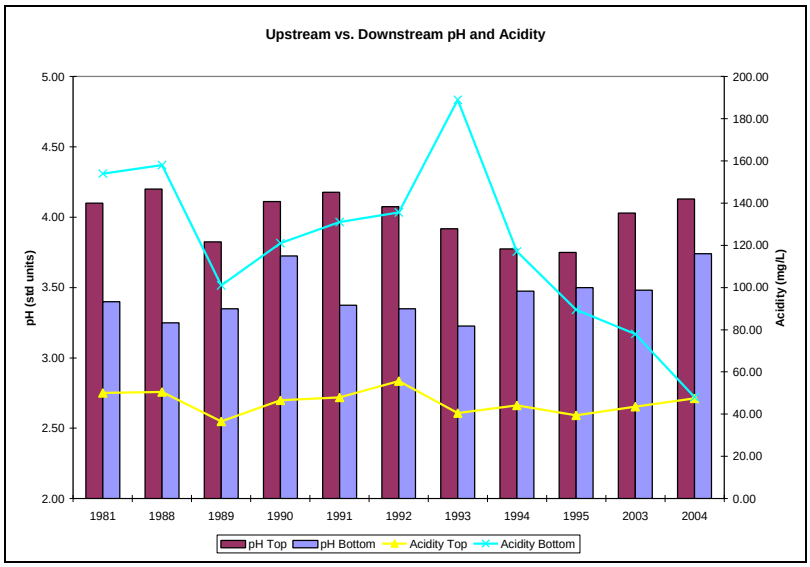
Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/14/03		3.6	597	74		0	1.56		4.51	6.74	242
7/23/03		3.4	785	72		0	4.32		4.82	10.1	338
9/18/03		3.5	880	100		0	2.28		6.41	10.7	299
10/22/03		3.6	804	82		0	4.39		5.59	9.32	268
11/18/03		3.5	557	42		0	4.49		4.2	6.33	220
3/18/04		3.8	683	63		0	2.12		5.19	8.16	265
4/21/04		3.7	680	49		0	1.37		4.26	7.66	265
9/16/04		3.7	638	44	0	0	1.63	0	4.12	8.48	261

ER-55

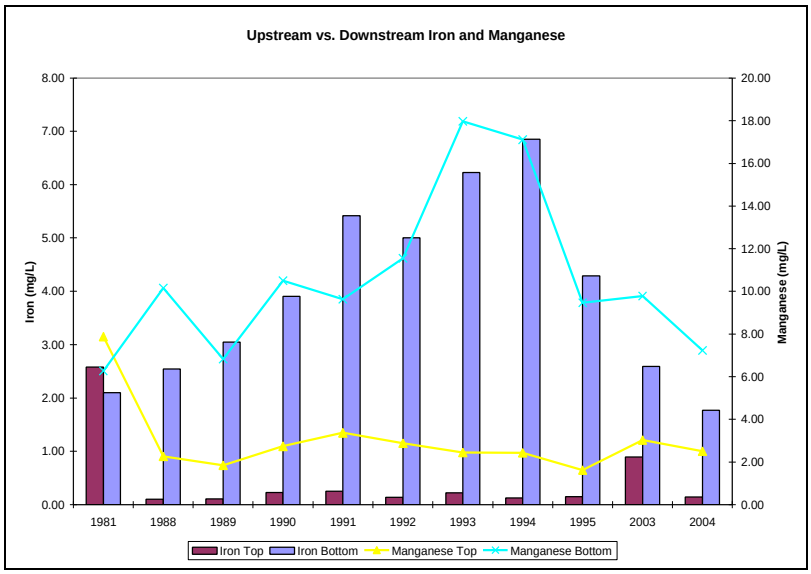
Table 39: Water Chemistry for ER-55

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/14/03		3.6	693	72		0	1.62		5.06	7.95	245
6/19/03		3.6	548	51		0	1.66		4.16	6.63	226
7/23/03		3.3	898	90		0	2.65		4.66	10.2	461
8/28/03		3.4	800	76		0	2.31		5.12	10.7	325
9/18/03		3.6	795	81		0	1.25		6.02	9.43	308
10/22/03		3.5	726	72		0	1.81		4.71	8.3	278
11/18/03		3.6	613	58		0	1.76		4.37	7.1	244
1/22/04		3.7	840	62		0	2.12		6.07	8.9	244
3/18/04		3.9	610	52		0	1.6		4.59	6.97	227
4/21/04		3.7	620	43		0	2.06		4.19	6.58	227
5/26/04		3.6	542	46		0	2.32		3.21	7.03	192
9/16/04		3.8	552	37	0	0	0.76	0	3.36	6.69	213
Ave		3.5	686.417	61.667	0	0	1.827	0	4.627	8.04	265.833
Max		3.9	898	90	0	0	2.65	0	6.07	10.7	461
Min		3.3	542	37	0	0	0.76	0	3.21	6.58	192
75% Conf		3.66	725.741	66.932	0	0	1.99	0	4.907	8.504	288.863
90% Conf		3.82	742.668	69.198	0	0	2.06	0	5.028	8.704	298.776

Comparison of Upstream (ER-1) vs. Downstream (ER-55)

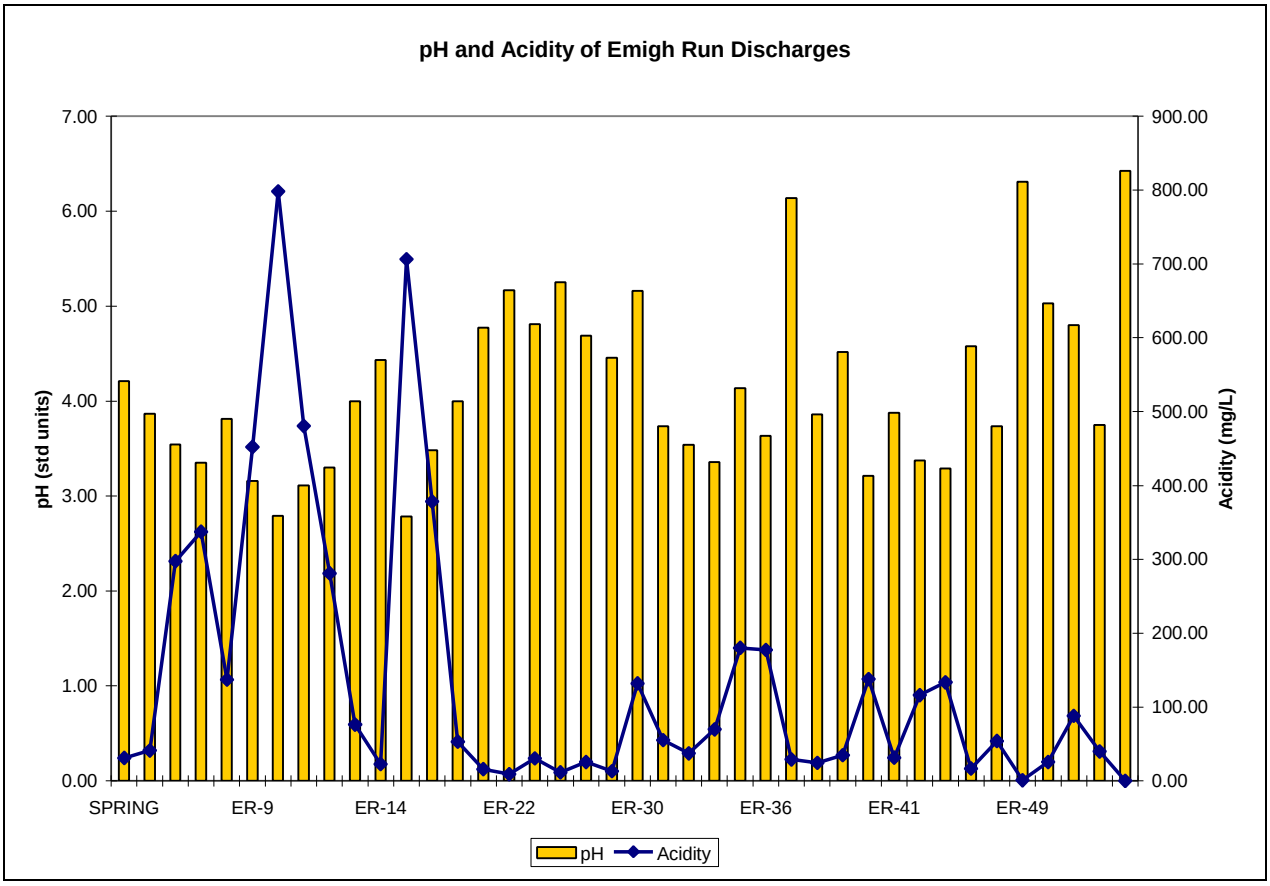


This graph represents the change in water quality from the headwaters of Emigh Run (top) to a sample collected below the Morrisdale Dam (bottom). The pH decreases from an average of 4.01 to 3.44 showing degradation from the discharges that enter along the length of the stream. The headwater area is degraded due to the geology of the area and an unknown source of pollution. Acidity concentrations increase from an average of 45.66 mg/L to 120.18 mg/L, again showing the degradation of stream quality caused by the mine drainage discharges entering the main stem of Emigh Run throughout the watershed.

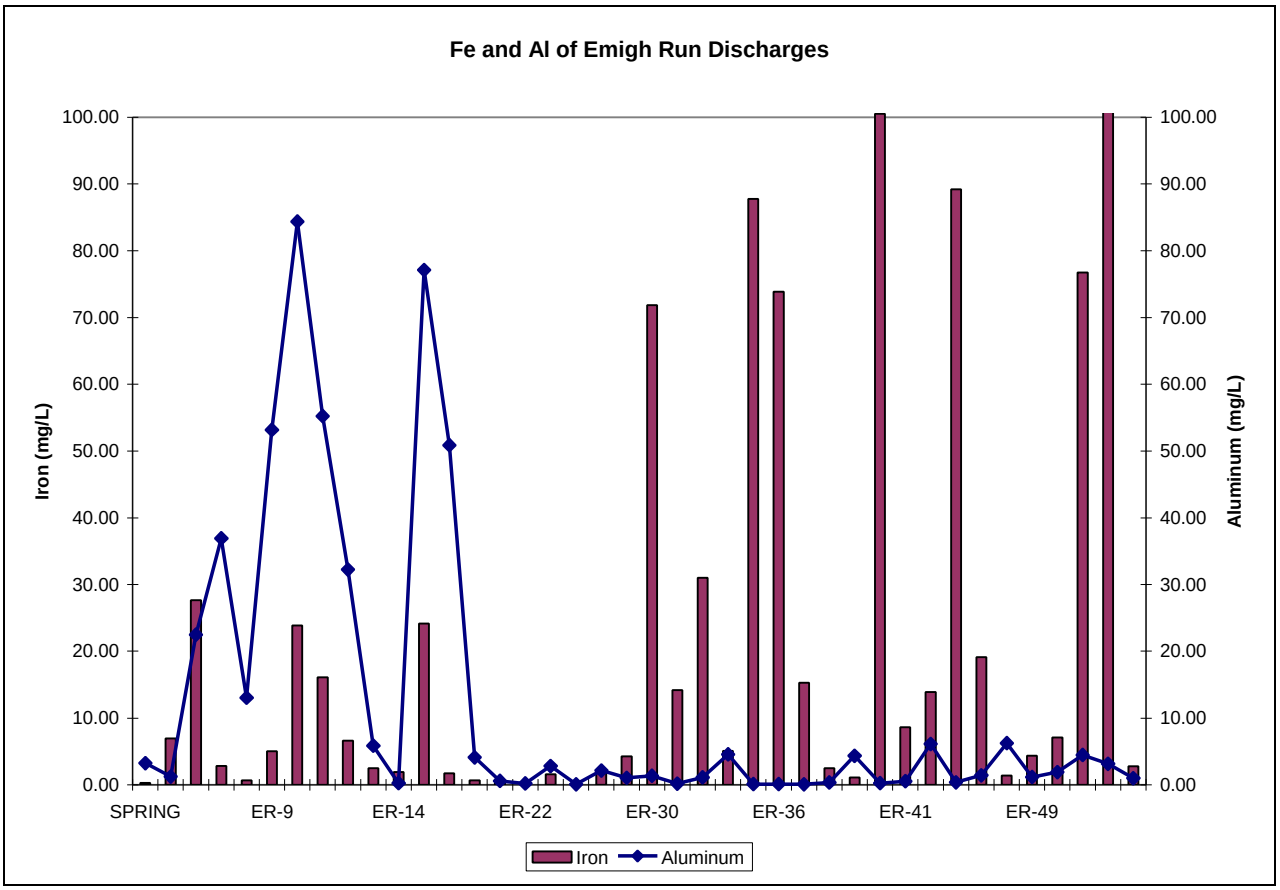


This graph represents the change in water quality from the headwaters of Emigh Run (top) to a sample collected below the Morrisdale Dam (bottom). The average iron concentration increases from 0.45 mg/L to 3.98 mg/L. Contrary to expectations, a substantial increase in concentrations is not seen due to the impacts of the discharges, especially the iron laden discharges in the lower section of the watershed. One explanation is that precipitation is occurring in the stream channel and also in the dam itself. Manganese concentrations increase from an average of 3.00 mg/L to 10.59 mg/L again showing the degradation of stream quality caused by the mine drainage discharges entering the main stem of Emigh Run throughout the watershed.

Comparison of Discharges



This graph represents the water quality, pH and acidity, of the numerous discharges entering Emigh Run. The x-axis represents the discharges themselves, going from the headwaters to the dam, with all labels of sample points not shown. The pH of the discharges range from 2.8 to an almost neutral quality of 6.7. This variation shows the range of discharges entering Emigh Run, impacting the overall water quality in the stream to varying degrees. Some of the alkaline discharges are acting as neutralizing agents of the main stem causing the precipitation of metals directly in the stream. The precipitate has created a stream bed uninhabitable to an aquatic community. Acidity concentrations of discharges also vary throughout the watershed. It is clearly shown that discharges in the headwaters are generally more acidic in nature than those in the lower part of the watershed. This is due to the higher concentrations of metals found in those discharges.



This graph represents the water quality, iron and aluminum, of the numerous discharges entering Emigh Run. The x-axis represents the discharges themselves, going from the headwaters to the dam, with all labels of sample points not shown. Iron concentration of the discharges range from minimal to values greater than 100 mg/L. Aluminum concentrations range from minimal to averaging slightly greater than 80 mg/L. The watershed is clearly divided in the chemistry of the discharges. In the upper reaches of the watershed, the discharges have a higher concentration of aluminum, while the discharges in the lower reaches are clearly characterized by high levels of iron. This is due to the different coal seems mined throughout the watershed and the varying geology present above and below those coal seams. This varying chemistry will cause different treatment approaches to be used, but all can be passively treated.

AMD Treatment Methods:

Through the years, many treatments have been developed for AMD remediation and currently there are a number of organized efforts in Pennsylvania using both active and passive treatment methods on a watershed scale. Active treatment methods incorporate the use of mechanized procedures for the addition of alkaline materials and require constant monitoring and maintenance. Basic chemicals are used as additives to increase the pH and cause the precipitation of metals, such as Fe, Mn, and Al. The chemicals commonly used are Ca(OH)2 (hydrated lime), NaOH (caustic soda), NH_3 (ammonia), CaO (pebble quicklime) and Na_2CO_3 (soda ash) (Robb and Robinson, 1995). The chemicals used on a particular site depend on mine drainage characteristics and site accessibility. Hydrated lime is commonly used, but is hydrophobic and requires mixing. Pebble quicklime (CaO) is utilized at sites where it is usually dissolved by a water wheel arrangement. Soda ash, in the form of briquettes, is used in remote areas with low flows and low acidity. Caustic soda is also used in remote areas with low flows. Liquid caustic soda is capable

of treating high acidity and high Mn because it raises the pH quickly, but it is expensive and dangerous to handle. Another potentially dangerous chemical used less frequently is ammonia. It must be handled carefully and is stored as a liquid. Ammonia can raise the pH above 9.2, but may have direct negative impacts on the biota of the receiving streams (Skousen and Ziemkiewicz, 1995).

Other active treatment methods include dissolved air flotation and ion exchange devices, flocculants, coagulants, and oxidants (Skousen and Ziemkiewicz, 1995). Active methods are successful, but expensive. It is not uncommon for water treatment costs to exceed $200,000 per year at AMD sites using active treatment. Another concern is the large volume of sludge produced from the precipitation of metals. Disposal costs for the sludge add to the cost of chemical treatment. Active methods may also cause environmental damage because potentially harmful chemicals are used. The high cost and possible side effects of active treatment can be avoided by the use of passive treatment systems.

Passive treatment systems, which require only limited maintenance, are the alternative approach to active treatment methods. They require no input of manufactured chemicals and have a lower operation and maintenance cost. A downside is that they do require longer retention times and larger treatment areas (Hedin et al., 1994). Page D-1 shows the evolution of passive treatment technology since the early 1980s. Passive treatment systems were first designed after it was observed that natural wetland systems in the path of AMD had some positive effects. The first passive systems described were natural *Sphagnum* wetlands that were improving AMD as discharges flowed through them. The first constructed wetlands were small and planted with cattails (*Typha latifolia)*. They were designed to encourage oxidation processes to precipitate unwanted metals and in turn increase the pH (Robb and Robinson, 1995). Constructed wetlands function by precipitating metal hydroxides, forming metal sulfides, and adsorbing small amounts of metals to the plant community (Skousen and Ziemkiewicz, 1995).

Two types of wetlands are constructed, aerobic and anaerobic. Aerobic wetland systems are designed to encourage metal precipitation through oxidation processes and are therefore normally shallow, vegetated, and have surface flow predominating (Robb and Robinson, 1995). Anaerobic wetland systems require that the mine water flow through an organic layer under anaerobic conditions. The organic material most commonly used is spent mushroom compost. This organic material must contain sulfate-reducing bacteria for metal sulfide precipitates to form (Robb and Robinson, 1995).

Both vegetation and bacteria are vital to wetland treatment success. Wetland plant species have many roles in mine drainage treatment. They include substrate consolidation, metal accumulation, stimulation of microbial activity and improve the aesthetics of the site. Constructed wetlands can also provide valuable wildlife habitat, for animals such as reptiles and amphibians. Plants may also serve as a food source. Sulfate reducing bacteria, such as *Desulfovibrio* and *Desulfotomaculum,* play a major role by increasing the pH and encouraging metal precipitation. It has been shown that *Desulfovibrio* are most effective at a pH > 4.5 so an important aspect of anaerobic wetland treatment is maintaining the pH within the organic layer (Nawrot and Klimstra, 1990). Sulfate reducers exist in the absence of oxygen and are only found in the deeper parts of the organic layer where they are able to perform their function of sulfate reduction and alkalinity production. Treatment efficiencies of these microbial dependent wetlands show trends of seasonal variation. The decrease in treatment efficiency may be due to biological functions slowing with decreasing temperatures (Kepler, 1990).

These bacteria utilize the organic substrate as a carbon source and use sulfate as an electron acceptor in the following reactions:

$$SO_4^{2-} + 2\ CH_2CHOHCOO^- + 4\ H^+ \rightarrow H_2S + 2\ CH_3COOH + 2\ H_2CO_3 \quad (1)$$

$$SO_4^{2-} + CH_3OO^- + 3\ H^+ \rightarrow H_2S + 2\ H_2CO_3 \quad (2)$$

$$SO_4^{2-} + 2\ CH_3CHOHCOO^- + 3\ H^+ \rightarrow 3H_2S + 6\ H_2CO_3 \quad (3)$$

Sulfate reducing bacteria cannot break down complex organic substrates so they rely mainly on fermenting bacteria to provide substrates like acetate and lactate from larger organic molecules (Cork and Cusanovich, 1979). Plants aid in maintaining these bacterial communities by providing attachment sites and a continual supply of organic matter (Skousen and Ziemkiewicz, 1995).

Another type of passive treatment technology is an anoxic limestone drain (ALD). The Tennessee Division of Water Pollution Control in 1988 first built prototype ALDs. At the same time, the Tennessee Valley Authority (TVA) personnel found that AMD from a coal refuse dam was being neutralized by calcium carbonate limestone in an old road buried beneath the dam (Brodie et al., 1993). In an ALD, alkalinity is produced when AMD contacts limestone in an anoxic environment producing bicarbonate alkalinity. ALDs consist of a shallow limestone filled trench, sealed from the atmosphere, through which the AMD is channeled. Limestone with greater than 90% $CaCO_3$ is used to produce the greatest amount of alkalinity (Brodie et al., 1993). The limestone layer is often covered with plastic or geotextile fabric. Clay soil is then placed over the plastic or fabric followed by a covering of a heavy soil, then vegetated. The amount of limestone used is determined by the flow and loading of the AMD and desired longevity for the system. Usually, extra limestone is employed to ensure a comfortable safety factor for longevity. The use of an oxidation basin immediately after the ALD allows for precipitation of the metals (Brodie et al., 1993).

Three other criteria are followed when constructing ALDs. The first is to keep out any organic matter that may allow microorganisms to grow and coat the limestone. The second is that larger limestone (1"-6") should be used to maintain flow in case plugging occurs due to metal precipitation. Finally, oxygen should be kept out of the drain to deter metal precipitates from forming (Skousen and Ziemkiewicz, 1995). ALDs have been found to raise pH and introduce as much as 300 mg/l of bicarbonate alkalinity as shown by the following equations:

$$CaCO_3\ (s) + 2\ H^+ \leftrightarrow Ca^{2+} + H_2CO_3^-\ (1)$$

$$CaCO_3\ (s) + H_2CO_3^- \leftrightarrow Ca^{2+} + 2\ HCO_3^-\ (2)$$

$$CaCO_3\ (s) + H_2O \leftrightarrow Ca^{2+} + HCO_3^- + OH^-\ (3)$$

The rate of calcium dissolution is dependent on carbon dioxide partial pressure. Generally, the rate of calcium dissolution will increase as the partial pressure increases (Plummer et al., 1979).

As the water leaves the ALD and is exposed to oxygen, the increased pH promotes metal precipitation and the bicarbonate alkalinity neutralizes the acidity produced by metal hydrolysis (Hedin and Watzlaf, 1994). Dissolved oxygen (DO) concentration is a limiting factor in the utility of ALDs. A DO level of less than 1.0 mg/l is recommended to ensure that Fe^{3+} will not precipitate, coating the limestone or clogging the system (Kepler and McCleary, 1994). Al^{3+}, however, can precipitate at a pH > 4.5 in the absence of oxygen, therefore clogging the system even in the absence of oxygen (Kepler and McCleary, 1994). ALDs are often used in combination with anaerobic constructed wetlands and vertical flow wetlands, which are also called successive alkalinity producing systems (SAPS) in the literature.

Vertical flow wetlands are being used on mine sites for the treatment of AMD (page D-2 and D-3). It is a newer technology that has shown great success. Vertical flow wetlands combine ALDs and anaerobic wetlands into one integrated system. Vertical flow is promoted through rich organic wetland substrates followed by a limestone bed (Kepler and McCleary, 1994). Most systems are constructed as ponds lined with 65-85 cm of limestone on which approximately 65 cm of spent mushroom compost is spread. To maintain reducing conditions within the organic layer, at least 85 cm of compost is recommended (Demchak, et al. 2001). On top of the compost layer is freestanding water with a depth of 40-255 cm (Skousen and Ziemkiewicz, 1995). Perforated pipes under the limestone layer collect the flow. Various piping patterns are used from a minimal approach where only 2-3 pipes are placed lengthwise through the system, to a maximal approach where piping is placed in a grid-like pattern on 5' or 10' centers. Demchak et al. recommends the use of increased piping to insure preferential flow does not occur.

Vertical flow wetlands add alkalinity both through bacterial sulfate reduction and limestone dissolution. Bacterial-mediated sulfate reduction occurs in the organic layer. Bacteria oxidize organic compounds using sulfate and release hydrogen sulfide and bicarbonate. The sulfate reduction directly affects concentrations of dissolved metals by raising alkalinity and providing the conditions necessary for precipitating them as metal sulfides (Skousen and Ziemkiewicz, 1995). Metals precipitating in the system may decrease the lifespan. Flushing the wetlands may be a solution to increasing the treatment success and may aid in the prevention of clogging. Acidic conditions may also be created from reactions involving H_2S, including $H_2S \rightarrow H^+ + HS^-$ and $Fe^{2+} + HS^- \rightarrow FeS + H^+$. When the mine water enters the organic layer containing dissolved Fe^{3+}, dissolved O_2, or precipitated Fe and Mn oxides, the H_2S is oxidized and mineral acidity is affected (Hedin et al., 1994). As the H_2S levels increase, the acidity decreases raising pH levels. The amount of H_2S produced can be qualitatively detected by both the odor of the gas and the rich black color of the organic layer which can be an indicator of successful treatment within the wetland (Nawrot and Klimstra, 1990).

Another source of bicarbonate in vertical flow wetlands is attributed to dissolution of the limestone, $CaCO_3 + H^+ \rightarrow Ca^{2+} + HCO_3^-$. The dissolution rate and concomitant alkalinity generation are greatly affected by the partial pressure of CO_2. Anaerobic mine water increases CO_2 partial pressures due to decomposing organic matter and precipitation of metal sulfides. The dissolved CO_2 is a weak diprotic acid and continues to react with limestone, producing more Ca^{2+} and HCO_3^-. When highly acidic water contacts limestone, the first reaction is neutralization of proton acidity. The reaction increases pH and decreases metal solubility. As pH rises above 4.5, bicarbonate accumulates, decreasing the solubility of metals (Hedin et al., 1994a). It has been stated that limestone dissolution requires a 12-hour contact time for maximum alkalinity production (Kepler and McCleary, 1994). In vertical flow wetlands, through a combination of bacterial mediated sulfate reduction and limestone dissolution, alkalinity is produced. The increased pH results in the precipitation of metals when the discharged water is exposed to oxygen.

Passive treatment technology is undergoing rapid development because of the importance of developing remediation methods for AMD at a low cost. Other systems are being studied to determine if they can be successfully used as cost-efficient systems, either alone or in combination with other systems. One such system is a limestone pond. The pond is constructed on an upwelling of an AMD seep or underground discharge point. Limestone is placed on the bottom of the pond and water flows up through it. They are normally constructed with 1-3 m of water, 0.3-1.0 m of limestone, and have a retention time of 1-2 days. The drainage requires a low DO, and should contain minimal Fe^{3+} and Al^{3+}, so clogging does not occur (Skousen and Ziemkiewicz, 1995). If higher concentrations of metals are present, a flushing system can be added.

Another technique involves the use of open limestone channels. They add alkalinity to acidic water in open channels or ditches lined with limestone. The channel should contain a slope greater than 20% to maintain flow velocities that keep precipitates in suspension (Skousen and Ziemkiewicz, 1995). Direct addition of limestone sand to streams is another technique being used. The sand is placed in the headwaters of a stream and during high flows the sand moves downstream and mixes with natural sediments. No harmful effects have been seen. An increase in pH and calcium levels have been observed along with a decrease in toxic aluminum species. A careful selection of particle size, purity and mass of the limestone is important for treatment success (Downey et al., 1994).

Diversion wells have been used in Scandinavia to treat small acidic streams since the late 1970's (Sverdrup, 1983). The first full-sized wells were implemented in Sweden in 1980 and were first used in Lebanon County, Pennsylvania in 1986. Diversion wells are constructed from a cylinder or vertical tank made of either concrete or metal. They are 1.5-1.8 m in diameter, 2.0-2.5 m deep and filled with limestone. They contain a large pipe that extends vertically down the center of the well. Water is fed from the stream into the pipe that exits near the bottom through a nozzle. Water then flows up through the limestone, fluidizing it. Grinding and dissolution of the limestone occurs creating alkalinity. Due to the high pressure created within the wells, floc is removed at a consistent rate, so limestone coating is not a

concern. Diversion wells are not entirely passive in that limestone must be added on a monthly basis and sometimes even daily. They work best where metal concentrations are low since there are no settling ponds employed.

Bioremediation is another passive treatment technique being used. Seeded microbes are used to convert metals to their less harmful species. Metal oxidation and precipitation are promoted through hydroxide formation, as is metal reduction and precipitation through sulfide formation. One example is the use of metal oxidizing beds for the treatment of both Mn and Fe (Skousen and Ziemkiewicz, 1995). Mn is difficult to remove because of the high pH required to precipitate it (> 9.0) and competition with Fe precipitation when Fe is present in high concentration. Researchers in Maryland have established a combination of microbes that have been shown to precipitate Mn to effluent standards. These beds have been in use for approximately 10 years, with the first being constructed in Pennsylvania in 1994.

Maintenance

Through discussions with the various project partners (Boggs and Morris Townships, the ERLWA and Moshannon Creek Watershed Coalition) long term maintenance of the constructed treatment systems will be conducted through a coordinated effort. The partners are willing to do the field work associated with maintenance of the treatment cells. An operation and maintenance plan will be developed for each treatment project as it enters final design. Potential problems are as follows:

Wetlands require minimal maintenance. Visual inspections are necessary to insure muskrats and beavers are not impacting inlet/outlet structures or destroying vegetation. Vertical flow wetlands require regular flushing to insure plugging does not occur. This flushing frequency will vary depending on the size of the system and metal loading entering the system. The primary maintenance issue is with solids removal in the settling ponds. The purpose of the settling pond is to collect precipitated metals. These solids accumulate over time and will eventually need to be removed. Ponds are typically designed to operate for 10 years or more before needing to be cleaned out.

Prioritization of Treatment Areas

The prioritization of treatment areas was based on a variety of criteria. Treatment areas are located throughout the watershed on property owned by individual landowners. Permission will need to be obtained when submitting grants in order to complete the design/permitting phase, along with construction of the projects. All landowners were contacted before the assessment began for permission to install flow devices on their property and conduct monthly sampling. Most landowners in the watershed are cooperative of the ERLWA efforts to restore Morrisdale Dam.

The water quality throughout the watershed is varied and will need varying technologies to treat. The stream has been divided into three segments for treatment prioritization. The top area, from the headwaters to the power line (ER-25) has water quality high in aluminum. The second area is from the power line to ER-32 which is the only reclamation project within the watershed. The discharges in this area are low flow with high iron. The third area continues to the Morrisdale Dam. This area has large iron discharges of laminar flow. Large settling basins will be necessary to precipitate the large iron load.

The treatment areas on Emigh Run are separated into “Priority areas”, “King Coal Related”, and “Other”. There are seven “Priority” treatment areas, and two have already received funding for design and permitting. Four projects are related to the area being remined or reclaimed by King Coal and will not be addressed until mining ceases. It is believed that reclamation will improve the water quality due to the lime being added to the backfill, along with decreased flows by vegetating the surface. Five projects fall under the “Other” category. These projects may or may not need to be constructed depending on the overall improvements from the “Priority” projects and those constructed after King Coal is finished. Conceptual designs have been included for all categories along with estimated costs.

Priority #1: Stream Relocation of the Headwaters

A schematic of the treatment system proposed for this priority can be found on page C-1 in Appendix C.

Site Description:

The headwaters of Emigh Run, ER-1, are being relocated from the existing channel which flows through a spoil area (where seepage enters the channel) into a newly constructed stream channel, which will flow through SPRING. The water will then re-enter Emigh Run above ER-2 which is in the existing stream channel. The degraded water quality from ER-1 to ER-2 is caused by seeps emanating from the spoil area. The stream will be relocated through a natural stream design project to the area/channel where SPRING now flows. The headwaters of Emigh Run emanate as a spring 300+ yards above ER-1. Due to the geology of the area and the extensive impacts from surrounding mining activities, the water quality emerges slightly degraded.

Table 40: Summary of Chemistry for ER-1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	31.292	4.058	229.667	44.833	15.362	1.333	0.636	0.322	5.166	2.857	75.5
Max	120	4.3	260	63	46.29	4	2	2.893	5.9	3.66	86
Min	7.5	3.9	189	32	4.521	0	0.05	0.018	4.11	2.28	64
75% Conf	41.401	4.098	235.615	47.2	19.328	1.828	0.867	0.581	5.359	3.007	78.048
90% Conf	45.753	4.115	238.175	48.218	21.036	2.041	0.967	0.692	5.442	3.072	79.145

Table 41: Summary of Chemistry for ER-2

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	40.235	3.518	360.273	51.636	23.726	0	1.99	0.907	3.506	3.221	93
Max	113	3.7	409	66	59.936	0	2.57	1.928	4.63	3.75	103
Min	3	3.3	321	44	1.917	0	1.37	0.072	2.7	2.65	75
75% Conf	51.345	3.567	371.928	54.138	29.42	0	2.144	1.128	3.729	3.338	95.801
90% Conf	56.127	3.588	376.944	55.215	31.87	0	2.21	1.223	3.825	3.388	97.007

Recommendations:

The existing channel from ER-1 flows on average 32 gpm with an average acidity of 44.83 mg/L, iron 0.64, and aluminum 5.17 mg/L. The stream increases in flow to an average of 40 gpm with an acidity of 51.64 mg/L, iron of 1.99 mg/L, and aluminum actually slightly decreases to 3.51 mg/L from precipitating in the stream channel. This degradation of water quality from ER-1 to ER-2 is due to seeps emanating from the spoil area where the stream channel now flows. The stream will be relocated through a natural stream design project to the channel where SPRING now flows. Appropriate limestone structures will be incorporated into this design, as will treatment cells constructed in the existing channel to treat the seeps from the spoil material. These cells will consist of limestone beds to aid in neutralization of the seeps.

Boggs Township has received funding for the design and permitting phase of this project through the Chesapeake Bay Small Watershed Grants program, along with supplemental funding through the Western Pennsylvania Small Watershed Grants Program. The total amount of Phase I of the project is $30,460.

The construction phase of the project will involve constructing the new stream channel and the construction of the limestone cells in the existing channel. A field meeting with OSM has resulted in verbal approval of the project. Formal grants will be submitted in the spring of 2005 for the construction phase of the project.

The approximate cost of constructing each limestone cell is $8,000 in the existing channel, for a total cost of $24,000. Construction of the new stream channel is estimated at $20,000 due to the addition of limestone structures to aid in neutralization. Miscellaneous costs of $5,000 are added for riparian plantings. The design and permitting phase has already been funded at a cost of $30,460. The overall design and construction cost of Treatment Area #1 is $79,460.

Predicted Effect of System on Receiving Stream:

The new stream channel will be diverted from the seeps entering from the spoil material. Water quality will be improved due to the addition of limestone structures for neutralization and the treatment of the seeps which will re-enter the channel near the present ER-2. The treatment of the headwaters will give an alkalinity boost to the overall stream quality. The goal is to restore an aquatic community to the headwaters in the form of aquatic insects.

Other:

A final O&M plan will be developed with the final stream and treatment cell design. Limited maintenance should be necessary, but the limestone cells may need to be modified or replaced after a 20+ year lifespan. Visual checks of the newly constructed stream channel and limestone cells will be made monthly to insure that wildlife or other natural processes are not affecting the integrity of the system. A field monitoring plan will be established to determine the overall effects of the project on water quality.

Permits will need to be obtained for the construction of the project. A field meeting with PADEP, PGC, PFBC, Army Corp of Engineers, Conservation District, and NMBS has occurred to insure all permitting issues are addressed.

Priority # 2: ER-13 and ER-14

A schematic of the treatment system proposed for this priority can be found on page C-2 in Appendix C.

Site Description:

ER-13 is a discharge channel created by toe of spoil seepage from a reclaimed surface mine site. Water seeps along the edge of the reclaimed area creating a large wet, iron laden dead zone. The water collects into a discrete channel that flows to Emigh Run. Two abandoned settling ponds also remain in the area, which also discharge to ER-13.

ER-14 is a channel which forms from seeps emanating from abandoned spoil with large conifers, but no ground cover. The channel flows through a wet area where a cranberry bog has developed and forms a channel entering Emigh Run.

Table 42: Summary of Chemistry for ER-13

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	110.483	3.95	771.25	77.917	46.115	1.75	2.349	1.039	6.003	16.022	338.25
Max	275	4.9	1240	136	106.323	6	6.04	3.081	9.77	26.5	687
Min	27.5	3.4	131	10	0.307	0	0.39	0.047	0.1	1.26	29
75% Conf	131.11	4.107	894.736	92.158	64.135	2.587	2.862	1.457	7.193	18.558	401.799
90% Conf	139.989	4.175	947.889	98.289	71.892	2.947	3.083	1.638	7.705	19.65	429.153

Table 43: Summary of Chemistry for ER-14

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	31.775	4.471	154.714	21.143	22.667	3.143	1.771	1.21	0.22	2.334	43.143
Max	142.1	4.7	254	76	130.187	6	3.99	6.835	0.32	5.58	94
Min	1.1	4	100	8	0.159	0	0.23	0.017	0.1	1.16	23
75% Conf	55.108	4.569	180.615	30.998	45.244	4.085	2.412	2.392	0.258	2.997	53.338
90% Conf	65.151	4.611	191.763	35.241	54.962	4.49	2.688	2.9	0.274	3.282	57.726

Recommendations:

This site has been investigated extensively to determine the best treatment option. Landowner approval has also been difficult to obtain. Permission was granted for design and construction when a Growing Greener grant was first submitted, but issues later developed. At this time, efforts are being made to construct a conveyance ditch collecting discharges ER-13 and ER-14 to the adjoining property. Through forfeited bond money on the site, PADEP is working with the landowners to remove the existing ponds and construct the conveyance ditch. Landowner permission has been obtained on the adjoining property. A Growing Greener grant has also been awarded to Morris Township for the design and permitting phase of this project. The grant was awarded in the amount of $52,000 which included the construction of a French drain system on the original property to gather all existing seeps. This grant will be amended when final treatment design is complete.

ER-13 has an average flow of 43 gpm with a maximum of 135 gpm during the sampling period. It is believed that flow may be higher than this on average. The acidity averages 77.92 mg/L, with an iron concentration of 2.35 mg/L, aluminum 6.0 mg/L, and manganese 16.02 mg/L. The chemistry of ER-14 is slightly different due to the different source. The average flow is 32 gpm with a maximum of 142 gpm. The acidity concentration is 21.14 mg/L, iron 1.77 mg/L, aluminum 0.22 mg/L, and manganese 2.33 mg/L. Monthly samples will be collected and flow measurements taken from the conveyance ditch to determine the final chemistry design. A mass balance was conducted on the two discharges with estimates of 277 gpm for total high flow, acidity of 48.74 mg/L, iron of 2.05 mg/L, aluminum of 3.03 mg/L and a manganese concentration of 9.0 mg/L. A combination of treatment cells will be used for this project.

The conveyance ditch will be approximately 400’ long to bring the flow from ER-13 and ER-14 to the adjoining property. The conveyance will have a flow regulation device installed before entering a vertical flow system containing 2000 tons of limestone with a size of 200’ x 100’.This system will consist of 3’ of limestone and 2’ of organic matter. It will have a grid like piping system. Due to the low concentrations of aluminum, flushing will not be a concern at this system. A flush valve will be included in the final design, but the system may only need to be flushed twice yearly and no additional piping will be incorporated. The VFW will be followed by a large settling pond. The discharge of the settling pond will enter another VFW comparison in size to the first. This will allow for maximum treatment during the high flow events. The second VFW will discharge to another settling pond, which will discharge to a final polishing wetland approximately 200’ by 100’. Discharge from the final wetland will flow into Emigh Run.

The approximate cost of constructing the treatment system is $224,000 as a total for each of the components. Each VFW will cost $92,000 followed by $10,000 for the settling ponds. The final polishing wetland will cost an additional $20,000. An additional $10,000 will be added to construction costs for project oversight. These are estimated costs and could change at the time of construction. Additional costs include design and permitting. The typical costs can be broken down to surveying costs at $4,500, permitting costs at $3,900, E&S Controls at $1,560, Design and Engineering costs at $16,950, Bid Packages at $2,600, and Other/Project Management at $2,600. These are typical costs to design and permit a treatment site. They vary slightly depending on the size of the project. The total costs for design

and permitting are therefore, $32,110. A miscellaneous amount of $20,000 is added to the project for mobilization/demobilization, etc. The overall design and construction cost of Treatment Area #2 is $276,110.

Predicted Effect of System on Receiving Stream:

The water discharging from the polishing wetland should be alkaline in nature with minimal iron and aluminum concentrations. The metals will be retained in the settling pond and wetland. The water discharging into Emigh Run will be able to support an aquatic community and will continue the neutralization of the main stem of Emigh Run.

Other:

A final O&M plan will be developed with the final design. Flushing will most likely be necessary twice a year due to the low aluminum concentrations. Additional maintenance will be removing precipitated metals from the settling pond. The pond will be designed for a 15+ year lifespan. Visual checks of the system will be made monthly to insure that wildlife is not affecting the integrity of the system. A field monitoring plan will be established to determine the overall effects of the treatment system on water quality.

Permits will need to be obtained for the construction of the system. A field meeting with PADEP, PGC, PFBC, Army Corp of Engineers, Conservation District, and NMBS will be conducted to insure all permitting issues are addressed.

This site has received funding for the design and permitting phase of the project. The construction phase will be submitted to the Growing Greener Program when all landowner issues have been resolved.

Priority # 3: ER-8

A schematic of the treatment system proposed for this priority can be found on page C-3 in Appendix C.

ER-8 is a seepage area emanating from under a haul road from a reclaimed surface mine area. The seepage creates numerous channels before becoming ponded along the stream bank. This discharge is above the King Coal area and enters from the opposite side of the stream. It is upstream from Priority #2, but due to the smaller flow was not a higher priority until the final restoration plan was complete.

Table 44: Summary of Chemistry ER-8

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	16.963	3.8	1154.9	133.7	25.132	0	0.715	0.217	12.626	27.7	527.7
Max	50	4	1350	181	50.027	0	2.33	1.404	16	30.7	633
Min	2	3.7	889	82	3.424	0	0.19	0.005	8.59	20.5	395
75% Conf	21.969	3.836	1209.204	144.065	31.292	0	0.943	0.363	13.461	28.759	554.575
90% Conf	24.123	3.852	1232.578	148.527	33.943	0	1.041	0.425	13.82	29.215	566.142

Recommendations:

A small upflow limestone pond using automatic flushing will be installed along with a settling pond. A polishing wetland will also be constructed.. The flow where the seepage was collected averages 17 gpm with an acidity concentration of 133.7 mg/L. Iron averages 0.72 mg/l, and aluminum is at 12.63 mg/L. Manganese averages 27.7 mg/L.

Excavation will occur along the haul road to locate the source of the discharge and collect it into one location. It will flow into an upflow limestone pond 140' by 80' with 1000 tons of limestone. This will discharge into a settling pond. A flushing system will be incorporated due to the moderate levels of aluminum. A final polishing wetland of 120' by 75'will be incorporated into the design.

The approximate cost of constructing the treatment system is $40,000 as a total for each of the components. The upflow limestone pond will cost approximately $25,000 to construct followed by the settling pond at $5,000. The polishing wetland will cost $10,000. Engineering costs and design costs will be less due to the size of the project. Miscellaneous costs for mobilization and demobilization, etc. are $10,000. Estimates of $18,500 for surveying, permitting and design are included. Costs for road construction, liners, etc. would add to the project. The overall design and construction cost of Other Area #1 is $68,500.

Predicted Effect of System on Receiving Stream:

The water discharging from the polishing wetland should be alkaline in nature with minimal iron and aluminum concentrations. The metals will be retained in the settling pond and wetland. The water discharging into Emigh Run will be able to support an aquatic community and will continue the neutralization of the main stem of Emigh Run.

Other:

A final O&M plan will be developed with the final design. An automatic flushing system may be included in the design of the upflow pond which will decrease the maintenance necessary. Moderate levels of aluminum are present, and flushing will enhance the long term performance of the system. Additional maintenance will include removing precipitated metals from the settling pond. The ponds will be designed for a 15+ year lifespan. Visual checks of the system will be made monthly to insure that wildlife is not affecting the integrity of the system. A field monitoring plan will be established to determine the overall effects of the treatment system on water quality.

Permits will need to be obtained for the construction of the system. A field meeting will be conducted with PADEP, PGC, PFBC, Army Corp of Engineers, Conservation District, and NMBS to insure all permitting issues are addressed.

This site will be submitted to both the Growing Greener Program and the Chesapeake Bay Small Watershed Grants Program for design and permitting monies. The construction phase will be submitted to Growing Greener and potentially OSM for funding.

Priority #4: ER-32

A schematic of the treatment system proposed for this priority can be found on page C-4 in Appendix C.

Site Description:

ER-32 is a small discharge, averaging only 6 gpm, which is emanating from a seepage area along a small, flat spoil area that needs to be reclaimed. The spoil is along both stream banks and in the stream channel itself. This project will include both a small reclamation project and a small passive treatment system.

Table 45: Summary of Chemistry for ER-32

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	5.606	3.527	402	36.727	2.301	0	28.342	1.235	1.074	4.453	109.545
Max	12	3.8	489	49	5.208	0	141	5.456	2.23	5.44	156
Min	1.275	3.4	324	25	0.538	0	1.45	0.042	0.52	3.51	87
75% Conf	6.742	3.569	419.648	39.673	2.771	0	45.559	1.884	1.237	4.664	116.678
90% Conf	7.231	3.587	427.244	40.942	2.974	0	52.97	2.163	1.307	4.754	119.748

Recommendations:

The first step in this priority project is the reclamation aspect. Reclamation would entail pulling the spoil material out of the stream and lining the edges with clay to prevent seepage into the stream. Slight grading work would be necessary along with appropriate ditching on the surface. The site would then be seeded and planted. The approximate area to be reclaimed is between 5-10 acres. Once reclamation is complete, determinations would be made to the extent of which ER-32 would need to be addressed.

ER-32 flows at an average rate of 6 gpm with an acidity concentration of 36.73 mg/L. The iron is 28.34 mg/L, aluminum 1.07 mg/L, and manganese of 4.45 mg/L. A small wetland system would be needed to allow for the iron to precipitate before entering the stream. The system will consist of a small VFW, 100' by 60' with 300 tons of limestone, followed by a settling pond using aeration techniques. A final aerobic wetland for metal precipitation will follow the pond discharging into Emigh Run.

The approximate cost of constructing the treatment system is $45,000 as a total for each of the components. The VFW will cost $20,000 followed by $5,000 for the settling pond. The aerobic wetland will cost an additional $20,000 to construct due to the use of a 2:1 combination of organic matter to limestone to insure alkalinity production and metal precipitation. An additional $5,000 will be added to construction costs for project oversight. These are estimated costs and could change at the time of construction.

Reclamation costs are included in the overall cost of this priority project. Estimates are made for reclaiming 10 acres of spoil material. Regrading is approximately $4,000/acre, revegetating, mulching and seeding is $1,000/acre, and the addition of lime at a rate of 20 tons/acre ($520/acre). The total reclamation cost is therefore $55,200.

Additional costs are design and permitting. The typical costs can be broken down to surveying costs at $4,500, permitting costs at $3,900, E&S Controls at $1,560, Design and Engineering costs at $16,950, Bid Packages at $2,600, and Other/Project Management at $2,600. These are typical costs to design and permit a treatment site. They vary slightly depending on the size of the project. The total costs for design and permitting are therefore, $32,110. Miscellaneous costs of $10,000 are added for mobilization/demobilization, etc. The overall design and construction cost of Treatment Area #3 is $147,310.

Predicted Effect of System on Receiving Stream:

The water discharging from the polishing wetland should be alkaline in nature with minimal iron and aluminum concentrations. The metals will be retained in the settling pond and wetland. The water discharging into Emigh Run will be able to support an aquatic community and will continue the neutralization of the main stem of Emigh Run.

Other:

A final O&M plan will be developed with the final design. Yearly flushing will most likely be necessary due to the low aluminum concentrations. Additional maintenance will be removing precipitated metals from the settling pond. The pond will be designed for a 15+ year lifespan. Visual checks of the system will be made monthly to insure that wildlife is not affecting the integrity of the system. A field monitoring plan will be established to determine the overall effects of the treatment system on water quality.

Permits will need to be obtained for the construction of the system and reclamation. A field meeting will occur with PADEP, PGC, PFBC, Army Corp of Engineers, Conservation District, and NMBS to insure all permitting issues are addressed.

This site will be submitted to both the Growing Greener Program and the Chesapeake Bay Small Watershed Grants Program for design and permitting monies. The construction phase will be submitted to Growing Greener and potentially OSM for funding.

Priority # 5: ER-35

A schematic of the treatment system proposed for this priority can be found on page C-5 in Appendix C.

Site Description:

ER-35 begins the above described Section 3 of Emigh Run which is the length of the stream to Morrisdale Dam. The chemistry changes in this area to iron laden discharges flowing over the surface creating large iron mats. ER-35 is a large iron laden discharge which emanates near the stream. There is no discrete location of flow. Flow was collected at one location, but seepage is entering the stream for approximately 100 yards on the bank. It is difficult to discern the source of the discharge as the area behind it is wooded. The area above the seepage zone was surface mined and reclaimed. It is believed that this must be the lowest point of the outcrop at the stream channel and therefore why the seepage occurs here.

Table 46: Summary of Chemistry for ER-35

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	14.72	4.183	1402.75	182.167	29.99	4.25	88.892	14.526	0.106	16.728	684.5
Max	24	5.9	1690	212	52.945	14	105	25.315	0.55	19.1	918
Min	1.5	3.1	713	54	3.616	0	21.5	1.635	0.03	6.63	254
75% Conf	17.173	4.456	1477.958	195.497	35.113	5.735	95.91	17.177	0.151	17.757	738.267
90% Conf	18.23	4.573	1510.33	201.234	37.318	6.375	98.931	18.319	0.171	18.2	761.411

Recommendations:

A collection ditch will be used to capture the flow into one discrete location and additional water quality analysis and flow measurements will be conducted to insure accurate final design. The flow where the seepage was collected averages 15 gpm, but an additional 10 gpm enters as seepage along the stream

bank. The acidity concentration is 182.17 mg/L with iron averaging 88.9 mg/l, but minimal aluminum at 0.11 mg/L. Manganese averages 16.73 mg/L. It will be difficult to remove due to the competition of precipitation with the high iron concentration. The primary goal of treatment will be to precipitate the iron before it enters the stream.

The first step in system design and construction is constructing a conveyance ditch to collect the seepage into one area. The conveyance ditch will be constructed 10+ feet below the surface to capture all subsurface flow. This will dry up the site for construction. The iron precipitate may need to be removed from the site or, at a minimum, relocated to the sides of the treatment area.

The system will consist of an initial pre-treatment pond approximately 125' by 125' to allow any iron to precipitate considering the average pH is 4.18. Aeration techniques will be included in this design. It will be followed by a 220' by 125' VFW to allow alkalinity generation for precipitation in the settling pond. This system will consist of 3' of limestone (2600 tons) and 2' of organic matter. It will have a grid like piping system which will also be used as a flushing system. The VFW will be followed by a large settling pond, which will also act as a flush pond. The discharge of the settling pond will enter another VFW equivalent in size to the first. It will discharge to another settling pond. A final polishing wetland 200' by 100' is included in the conceptual design.

The approximate cost of constructing the treatment system is $250,000 as a total for each of the components. The initial pre-treatment pond will be $10,000. Each VFW will cost $105,000 followed by $5,000 for each settling pond. The polishing wetland will cost an additional $20,000. An additional $10,000 will be added to construction costs for project oversight. These are estimated costs and could change at the time of construction. Additional costs are design and permitting. The typical costs can be broken down to surveying costs at $4,500, permitting costs at $3,900, E&S Controls at $1,560, Design and Engineering costs at $16,950, Bid Packages at $2,600, and Other/Project Management at $2,600. These are typical costs to design and permit a treatment site. They vary slightly depending on the size of the project. The total costs for design and permitting are therefore, $32,110. Miscellaneous costs of $20,000 are added for mobilization/demobilization, etc. Costs for road construction, liners, etc. would add to the project. The overall design and construction cost of Treatment Area #4 is $312,110.

Predicted Effect of System on Receiving Stream:

The water discharging from the polishing wetland should be alkaline in nature with minimal iron and aluminum concentrations. The metals will be retained in the settling pond and wetland. The water discharging into Emigh Run will be able to support an aquatic community and will continue the neutralization of the main stem of Emigh Run.

Other:

A final O&M plan will be developed with the final design. Quarterly flushing of the VFW may be necessary. Low levels of aluminum are present, but the high levels of iron may benefit from quarterly flush events to keep iron floc from plugging pipes or forming layers on the organic matter. Additional maintenance will be removing precipitated metals from the settling pond. The ponds will be designed for a 15+ year lifespan. Visual checks of the system will be made monthly to insure that wildlife is not affecting the integrity of the system. A field monitoring plan will be established to determine the overall effects of the treatment system on water quality.

Permits will need to be obtained for the construction of the system. A field meeting will be conducted with PADEP, PGC, PFBC, Army Corp of Engineers, Conservation District, and NMBS to insure all permitting issues are addressed.

This project will be submitted to both the Growing Greener Program and the Chesapeake Bay Small Watershed Grants Program for design and permitting monies. The construction phase will be submitted to Growing Greener and potentially OSM for funding.

Priority # 6: ER-40

A schematic of the treatment system proposed for this priority can be found on page C-6 in Appendix C.

ER-40 is a large iron seep creating an iron mat which enters Emigh Run. This site is similar in nature to ER-35. No discrete location for the discharge could be located. Flow was obtained at one location, but seepage enters along the stream bank making accurate flow measurements difficult. Treatment would entail capturing the flow into one location and precipitating the iron.

Table 47: Summary of Chemistry ER-40

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	7.013	3.213	1582.5	137.625	9.507	0	100.538	4.972	0.242	13.112	673.125
Max	35.1	3.5	1780	160	39.774	0	283	10.235	0.84	15.5	845
Min	1.5	3.1	1060	94	2.061	0	22.9	0.852	0.05	7.6	427
75% Conf	11.361	3.268	1668.648	146.293	14.242	0	133.897	6.527	0.337	14.105	721.09
90% Conf	13.233	3.292	1705.729	150.024	16.279	0	148.256	7.196	0.378	14.533	741.736

Recommendations:

A collection ditch will be used to capture the flow into one discrete location and additional water quality analysis and flow measurements will be conducted to insure accurate final design. The flow where the seepage was collected averages 7 gpm, but an additional 10 gpm enters as seepage along the stream bank. The acidity concentration is 137.63 mg/L with iron averaging 100.54 mg/l, but minimal aluminum at 0.24 mg/L. Manganese averages 13.11 mg/L. It will be difficult to remove due to the competition of precipitation with the high iron concentration. The primary goal of treatment will be to precipitate the iron before it enters the stream.

Due to the lower pH at this site, a buried ALD, 100’ by 25’ with 500 tons of limestone, may be used to increase the pH for iron precipitation in the pretreatment pond. Dissolved oxygen measurements will be collected to determine if this is a feasible approach. The ALD will flow into a pre-treatment pond approximately 125’ by 75’ to allow any iron to precipitate. Aeration techniques will be included in this design. It will be followed by a 200’ by 110’ VFW to allow alkalinity generation for precipitation in the settling pond. This system will consist of 3’ of limestone (2000 tons) and 2’ of organic matter. It will have a grid like piping system which will also be used as a flushing system. The VFW will be followed by a large settling pond, which will also act as a flush pond. The discharge of the settling pond will enter a final polishing wetland 200’ by 100’.

The approximate cost of constructing the treatment system is $127,000 as a total for each of the components. The ALD will cost $12,000 to construct followed by the initial pre-treatment pond at $5,000. The VFW will cost $85,000 followed by $5,000 for the settling pond. The polishing wetland will cost an additional $20,000. An additional $10,000 will be added to construction costs for project oversight. These are estimated costs and could change at the time of construction. Additional costs are design and permitting. The typical costs can be broken down to surveying costs at $4,500, permitting costs at $3,900, E&S Controls at $1,560, Design and Engineering costs at $16,950, Bid Packages at $2,600, and Other/Project Management at $2,600. These are typical costs to design and permit a treatment site. They vary slightly depending on the size of the project. The total costs for design and permitting are therefore, $32,110. Miscellaneous costs of $20,000 are added for mobilization/demobilization, etc. Costs for road construction, liners, etc. would add to the project. The overall design and construction cost of Treatment Area #5 is $189,110.

Predicted Effect of System on Receiving Stream:

The water discharging from the polishing wetland should be alkaline in nature with minimal iron and aluminum concentrations. The metals will be retained in the settling pond and wetland. The water discharging into Emigh Run will be able to support an aquatic community and will continue the neutralization of the main stem of Emigh Run.

Other:

A final O&M plan will be developed with the final design. Quarterly flushing of the VFW may be necessary. Low levels of aluminum are present, but the high levels of iron may benefit from quarterly flush events to keep iron floc from plugging pipes or forming layers on the organic matter. Additional maintenance will include removing precipitated metals from the settling pond. The ponds will be designed for a 15+ year lifespan. Visual checks of the system will be made monthly to insure that wildlife is not affecting the integrity of the system. A field monitoring plan will be established to determine the overall effects of the treatment system on water quality.

Permits will need to be obtained for the construction of the system. A field meeting will be conducted with PADEP, PGC, PFBC, Army Corp of Engineers, Conservation District, and NMBS to insure all permitting issues are addressed.

This site will be submitted to both the Growing Greener Program and the Chesapeake Bay Small Watershed Grants Program for design and permitting monies. The construction phase will be submitted to Growing Greener and potentially OSM for funding.

Priority # 7: ER-44

A schematic of the treatment system proposed for this priority can be found on page C-7 in Appendix C.

ER-44 is another large iron seep creating an iron mat which enters Emigh Run. This site is similar in nature to ER-35 and ER-40, but the iron concentrations are much lower. No discrete location for the discharge could be located. There was no way to collect flow at this site. Estimates were made of up to 250 gpm. No discrete location for the seepage could be found and it could not be tied back to any location. Access to this site is difficult and will have to be further investigated. Treatment would entail capturing the flow into one location and precipitating the iron.

Table 48: Summary of Chemistry ER-44

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	250	3.375	1265.583	118.583	270.027	0	20.382	13.206	5.637	13.298	587.667
Max	300	3.7	4670	322	303.781	0	91.6	14.659	10.1	30.2	2517
Min	200	2.8	435	48	236.274	0	3.25	11.753	0.27	5.18	151
75% Conf	290.659	3.456	1627.137	140.527	297.475	0	29.326	14.387	6.672	15.386	795.133
90% Conf	308.16	3.492	1782.762	149.973	309.289	0	33.176	14.896	7.117	16.285	884.434

Recommendations:

A collection ditch will be used to capture the flow into one discrete location and additional water quality analysis and flow measurements will be conducted to insure accurate final design. Flow estimates at the site average 250 gpm. The acidity concentration is 118.58 mg/L with iron averaging 20.38 mg/l, and aluminum at 5.64 mg/L. Manganese averages 13.3 mg/L. The primary goal of treatment will be to precipitate the iron and aluminum before it enters the stream.

A collection ditch will be constructed to concentrate the flow into one location. It will then enter a VFW 200' by 115' with 2400 tons of limestone. The VFW will allow alkalinity generation for precipitation of metals in the settling pond. This system will consist of 3' of limestone and 2' of organic matter. It will have a grid like piping system which will also be used as a flushing system. The VFW will be followed by a large settling pond, which will also act as a flush pond. Another VFW of similar size will follow due to the higher flow rate, hence loading at this site. Again, a settling pond will follow the VFW. The discharge of the settling pond will enter a final polishing wetland 200' by 100'.

The approximate cost of constructing the treatment system is $230,000 as a total for each of the components. Each VFW will cost $100,000 followed by $5,000 for each settling pond. The polishing wetland will cost an additional $20,000. An additional $10,000 will be added to construction costs for project oversight. These are estimated costs and could change at the time of construction. Additional costs are design and permitting. The typical costs can be broken down to surveying costs at $4,500, permitting costs at $3,900, E&S Controls at $1,560, Design and Engineering costs at $16,950, Bid Packages at $2,600, and Other/Project Management at $2,600. These are typical costs to design and permit a treatment site. They vary slightly depending on the size of the project. The total costs for design and permitting are therefore, $32,110. Miscellaneous costs of $20,000 are added for mobilization/demobilization, etc. Costs for road construction, liners, etc. would add to the project. The overall design and construction cost of Treatment Area #6 is $282,110.

Predicted Effect of System on Receiving Stream:

The water discharging from the polishing wetland should be alkaline in nature with minimal iron and aluminum concentrations. The metals will be retained in the settling pond and wetland. The water discharging into Emigh Run will be able to support an aquatic community and will continue the neutralization of the main stem of Emigh Run.

Other:

A final O&M plan will be developed with the final design. Quarterly flushing may be necessary of the VFW. Low levels of aluminum are present, but the higher iron levels may benefit from quarterly flush events to keep iron floc from plugging pipes or forming layers on the organic matter. Additional maintenance will be removing precipitated metals from the settling pond. The ponds will be designed for a 15+ year lifespan. Visual checks of the system will be made monthly to insure that wildlife is not affecting the integrity of the system. A field monitoring plan will be established to determine the overall effects of the treatment system on water quality.

Permits will need to be obtained for the construction of the system. A field meeting will be conducted with PADEP, PGC, PFBC, Army Corp of Engineers, Conservation District, and NMBS to insure all permitting issues are addressed.

This project will be submitted to both the Growing Greener Program and the Chesapeake Bay Small Watershed Grants Program for design and permitting monies. The construction phase will be submitted to Growing Greener and potentially OSM for funding.

King Coal Related, Priority Area 1: ER-6

A schematic of the treatment system proposed for this priority can be found on page C-8 in Appendix C.

ER-6 is a laminar flow seep emanating from the toe of a reclaimed surface mine area. A discrete source can be located, but flow could not be accurately measured. A large area is affected. An iron mat with precipitate has formed creating a kill zone that flows directly into Emigh Run. Excavation further up the hillside would be necessary to gather and treat the discharge. Samples would be collected for further analysis and accurate flow rates determined.

Table 49: Summary of Chemistry ER-6

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	19	3.311	2146.667	329.111	84.219	0	30.8	7.638	24.711	43.144	1153.111
Max	50	3.4	2540	408	227.233	0	40.5	20.493	28.4	47.6	1383
Min	1	3.2	1960	277	3.725	0	25.1	0.368	20.1	38.9	935
75% Conf	33.617	3.333	2220.069	344.794	151.538	0	32.62	13.691	25.882	44.112	1218.049
90% Conf	39.909	3.342	2251.665	351.545	180.515	0	33.403	16.296	26.385	44.528	1246.001

Recommendations:

A collection ditch will be used to capture the flow into one discrete location and additional water quality analysis and flow measurements will be conducted to insure accurate final design. The estimated flow ranges from 5 to 50 gpm. The acidity concentration is 329 mg/L with iron averaging 30.8 mg/l and aluminum at 24.7 mg/L. Manganese averages 43.14 mg/L. These are high metal concentrations but with the continued reclamation on the above Avery Tipple and Graham Brothers site an improvement should be seen in both chemistry and flow rate. By constructing a VFW with layered piping and regular flushing, passive treatment may be possible.

The collection ditch will enter the first of two VFW. The first will be sized at 150’ x 85’ with 1,000 tons of limestone. They will each have a layered piping system, with the top layer near the surface of the limestone to act as a separate flushing system. The first VFW will empty into a settling pond, followed by the second VFW with similar design. The VFW systems will consist of 3’ of limestone and 2’ of organic matter. It will have a grid like piping system which will also be used as a flushing system. The discharge of the second settling pond will enter a manganese removal bed 250’ x 125’. This treatment cell will discharge into a final polishing wetland.

The approximate cost of constructing the treatment system is $174,000 as a total for each of the components. Each VFW will cost $62,000 followed by $5,000 for each settling pond. The polishing wetland will cost an additional $20,000, along with $22,000 for the manganese removal bed. An additional $10,000 will be added to construction costs for project oversight. These are estimated costs and could change at the time of construction. Additional costs are design and permitting. The typical costs can be broken down to surveying costs at $4,500, permitting costs at $3,900, E&S Controls at $1,560, Design and Engineering costs at $16,950, Bid Packages at $2,600, and Other/Project Management at $2,600. These are typical costs to design and permit a treatment site. They vary slightly depending on the size of the project. The total costs for design and permitting are therefore, $32,110. Miscellaneous costs of $20,000 are added for mobilization/demobilization, etc. Costs for road construction, liners, etc. would add to the project. The overall design and construction cost of Treatment Area #1 is $236,110.

Predicted Effect of System on Receiving Stream:

The water discharging from the polishing wetland should be alkaline in nature with minimal iron and aluminum concentrations. The metals will be retained in the settling pond and wetland. The water discharging into Emigh Run will be able to support an aquatic community and will continue the neutralization of the main stem of Emigh Run.

Other:

A final O&M plan will be developed with the final design. Monthly flushing may be necessary of the VFW. High concentration of aluminum is present and regular flushing will insure the treatment cells do not plug from the amorphous precipitate. Additional maintenance will be removing precipitated metals from the settling pond. The ponds will be designed for a 15+ year lifespan. Visual checks of the system will be made monthly to insure that wildlife is not affecting the integrity of the system. A field monitoring plan will be established to determine the overall effects of the treatment system on water quality.

Permits will need to be obtained for the construction of the system. A field meeting will be conducted with PADEP, PGC, PFBC, Army Corp of Engineers, Conservation District, and NMBS to insure all permitting issues are addressed.

This project will be submitted to both the Growing Greener Program and the Chesapeake Bay Small Watershed Grants Program for design and permitting monies. The construction phase will be submitted to Growing Greener and potentially OSM for funding.

King Coal Related, Priority Area 2: ER-9

A schematic of the treatment system proposed for this priority can be found on page C-9 in Appendix C.

ER-9 is an aluminum laden discharge seeping from the toe of spoil of the reclaimed surface mine site where King Coal is now remining. The seep starts high on the hillside where remining activities will occur, then forms a discrete channel creating a dead zone to Emigh Run.

Table 50: Summary of Chemistry ER-9

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	16.291	3.164	2202.091	450.455	67.566	0	4.805	1.115	52.745	32.509	1187.818
Max	80	3.6	2790	734	183.233	0	11.5	7.378	71.9	38.8	1758
Min	4	2.9	883	190	18.998	0	2.04	0.124	25.5	12.6	361
75% Conf	23.481	3.227	2363.628	496.878	83.2	0	5.755	1.806	56.58	34.827	1304.801
90% Conf	26.576	3.254	2433.159	516.861	89.929	0	6.164	2.103	58.231	35.824	1355.155

Recommendations:

Two alternatives are being considered for this site and final determination will be made when mining activities are complete. Treatment will either occur at the top of the hill following the contour or will be constructed in the channel that has been created by the discharge. The treatment schematic is the same; it is the location that varies.

The pH averages 3.16 with an average flow of 16 gpm. The acidity concentration is 450 mg/L with iron averaging 4.8 mg/L and aluminum averaging 52.75 mg/L. The manganese averages 32.51 mg/L. This discharge is pushing the limits of passive treatment technology, but through the new design of upflow ponds being used by BAMR with flushing systems included, it may be possible. The flow rates are manageable and again it is believed that the chemistry will improve as remining activities occur on site.

Treatment will begin with an anaerobic wetland, 200'by 100' to remove the iron. A limestone bed with flushing mechanisms will follow. It will be sized at 240' by 120' with 3400 tons of limestone. It will contain two layers of piping to insure complete flushing of the limestone layer to limit the possibility of plugging from the amorphous aluminum precipitate. The limestone pond will discharge into a large settling pond. The settling pond effluent will enter a manganese removal bed, 175' by 100' and finally a polishing wetland, 200' by 100'.

The approximate cost of constructing the treatment system is $168,000 as a total for each of the components. The anaerobic wetland will cost $30,000, followed by the limestone pond at $96,000. The settling pond will cost approximately $10,000 to construct along with $12,000 for the manganese removal bed and $20,000 for the polishing wetland. An additional $10,000 will be added to construction costs for project oversight. These are estimated costs and could change at time of construction. Additional costs are design and permitting. The typical costs can be broken down to surveying costs at $4,500, permitting costs at $3,900, E&S Controls at $1,560, Design and Engineering costs at $16,950, Bid Packages at $2,600, and Other/Project Management at $2,600. These are typical costs to design and permit a treatment site. They vary slightly depending on the size of the project. The total costs for design and permitting are therefore, $32,110. Miscellaneous costs of $20,000 are added for mobilization/demobilization, etc. Costs for road construction, liners, etc. would add to the project. The overall design and construction cost of Treatment Area #2 is $230,110.

Predicted Effect of System on Receiving Stream:

The water discharging from the polishing wetland should be alkaline in nature with minimal iron and aluminum concentrations. The metals will be retained in the settling pond and wetland. The water discharging into Emigh Run will be able to support an aquatic community and will continue the neutralization of the main stem of Emigh Run.

Other:

A final O&M plan will be developed with the final design. Monthly flushing may be necessary of the limestone pond. High concentration of aluminum is present and regular flushing will insure the treatment cells do not plug from the amorphous precipitate. Additional maintenance will be removing precipitated metals from the settling pond. The ponds will be designed for a 15+ year lifespan. Visual checks of the system will be made monthly to insure that wildlife is not affecting the integrity of the system. A field monitoring plan will be established to determine the overall effects of the treatment system on water quality.

Permits will need to be obtained for the construction of the system. A field meeting will be conducted with PADEP, PGC, PFBC, Army Corp of Engineers, Conservation District, and NMBS to insure all permitting issues are addressed.

This project will be submitted to both the Growing Greener Program and the Chesapeake Bay Small Watershed Grants Program for design and permitting monies. The construction phase will be submitted to Growing Greener and potentially OSM for funding.

King Coal Related, Priority Area 3: ER-10

A schematic of the treatment system proposed for this priority can be found on page C-10 in Appendix C.

ER-10 emanates from the same area as ER-9, as a seep from the reclaimed area where King Coal is remining, but further downstream. ER-10 discharges and forms a discrete channel to Emigh Run. It is again aluminum laden with a higher concentration of iron.

Table 51: Summary of Chemistry ER-10

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	6.864	2.791	3010.909	785.909	52.483	0	22.736	1.908	82.436	29.795	1501.455
Max	30	3.1	4540	1148	135.737	0	57.1	6.883	108	34.8	2269
Min	1	2.5	1130	296	8.933	0	10.8	0.231	33.9	9.85	368
75% Conf	9.852	2.851	3357.765	865.037	67.301	0	26.98	2.697	88.988	32.194	1670.485
90% Conf	11.138	2.877	3507.064	899.096	73.68	0	28.806	3.036	91.809	33.226	1743.242

Recommendations:

Two alternatives are being considered for this site and final determination will be made when mining activities are complete. Treatment will either occur at the top of the hill following the contour or will be constructed in the channel that has been created by the discharge. The treatment schematic is the same; it is the location that varies.

The pH averages 2.79 with an average flow of 7 gpm. The acidity concentration is 785 mg/L with iron averaging 22.74 mg/L and aluminum averaging 82.44 mg/L. The manganese averages 29.80 mg/L. This discharge is pushing the limits of passive treatment technology, but through the new design of upflow ponds being used by BAMR with flushing systems included, it may be possible. The flow rates are manageable and again it is believed that the chemistry will improve as remining activities occur on site. Also, due to other improvements occurring upstream of this discharge, if the metals can be treated partially, a positive impact will still be seen in Emigh Run. Flushing will again be important to the success of the treatment. The treatment design will be similar to ER-9; the biggest difference being the higher concentration of iron. It will hopefully be pretreated through an anaerobic wetland to decrease the chance of limestone coating in the limestone pond.

Treatment will begin with an anaerobic wetland, 250'by 150' to remove the iron. A limestone bed with flushing mechanisms will follow. It will be sized at 250' by 125' with 3000 tons of limestone. It will contain two layers of piping to insure complete flushing of the limestone layer to limit the possibility of plugging from the amorphous aluminum precipitate. The limestone pond will discharge into a large settling pond. The settling pond effluent will enter a manganese removal bed, 140' by 75' and finally a polishing wetland, 200' by 100'.

The approximate cost of constructing the treatment system is $175,000 as a total for each of the components. The anaerobic wetland will cost $60,000, followed by the limestone pond at $75,000. The settling pond will cost approximately $10,000 to construct along with $10,000 for the manganese removal bed and $20,000 for the polishing wetland. An additional $10,000 will be added to construction costs for project oversight. These are estimated costs and could change at the time of construction. Additional costs are design and permitting. The typical costs can be broken down to surveying costs at $4,500, permitting costs at $3,900, E&S Controls at $1,560, Design and Engineering costs at $16,950, Bid Packages at $2,600, and Other/Project Management at $2,600. These are typical costs to design and permit a treatment site. They vary slightly depending on the size of the project. The total costs for design and permitting are therefore, $32,110. Miscellaneous costs of $20,000 are added for mobilization/demobilization, etc. Costs for road construction, liners, etc. would add to the project. The overall design and construction cost of Treatment Area #3 is $237,110.

Predicted Effect of System on Receiving Stream:

The water discharging from the polishing wetland will not be treated completely but will be treated to 75% metal removal. The precipitated metals will be retained in the settling pond and wetland. The water discharging into Emigh Run will be greatly improved from the discharge quality and will be neutralized by the improvements already seen from upstream systems on Emigh Run.

Other:

A final O&M plan will be developed with the final design. Monthly flushing of the limestone pond may be necessary. High concentration of aluminum is present and regular flushing will insure the treatment cells do not plug from the amorphous precipitate. Additional maintenance will be removing precipitated metals from the settling pond. The ponds will be designed for a 15+ year lifespan. Visual checks of the system will be made monthly to insure that wildlife is not affecting the integrity of the system. A field monitoring plan will be established to determine the overall effects of the treatment system on water quality.

Permits will need to be obtained for the construction of the system. A field meeting will be conducted with PADEP, PGC, PFBC, Army Corp of Engineers, Conservation District, and NMBS to insure all permitting issues are addressed.

This project will be submitted to both the Growing Greener Program and the Chesapeake Bay Small Watershed Grants Program for design and permitting monies. The construction phase will be submitted to Growing Greener and potentially OSM for funding.

King Coal Related, Priority Area 4: ER-12

A schematic of the treatment system proposed for this priority can be found on page C-11 in Appendix C.

ER-12 needs to be further monitored before a final decision can be made on its prioritization for treatment. Flow has fluctuated greatly at this site, ranging from 1 to 200 gpm. The lowest flow rates occurred during the final months of sampling. This may have been due to the remining efforts occurring on the Avery Tipple property by King Coal. The discharge emanates at approximately the same contour at ER-9 and ER-10 forming a discrete channel to Emigh Run. A conceptual design has been included using the average flow, but further monitoring will occur.

Table 52: Summary of Chemistry ER-12

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	53.25	3.229	1219.143	295.429	115.527	0	7.374	3.93	32.729	16.359	462.714
Max	200	3.9	1870	661	458.082	0	19	18.95	79.8	26	784
Min	1	2.7	624	100	4.605	0	1.96	0.07	8.7	4.3	193
75% Conf	86.223	3.417	1371.416	381.411	189.823	0	9.91	7.099	43.903	19.636	536.666
90% Conf	100.415	3.498	1436.96	418.42	221.803	0	11.002	8.462	48.713	21.046	568.498

Recommendations:

Two alternatives are being considered for this site and final determination will be made when mining activities are complete. Treatment will either occur at the top of the hill following the contour or will be constructed in the channel that has been created by the discharge. The treatment schematic is the same; it is the location that varies.

The pH averages 3.23 with an average flow of 53.25 gpm. The acidity concentration is 295 mg/L with iron averaging 7.37 mg/L and aluminum averaging 32.73 mg/L. The manganese averages 16.36 mg/L. This discharge can be passively treated, as long as regular flushing of the VFW's occurs.

Treatment will begin with a VFW 230' by 125' (3000 tons of limestone) which contains an extensive flushing system. It will contain two layers of piping to insure complete flushing of the limestone layer to limit the possibility of plugging from the amorphous aluminum precipitate. The VFW will discharge into a large settling pond and enter another VFW with similar design to the first. It will have a 3' layer of limestone and 2' of organic matter. The second VFW will discharge to a second settling pond. The

settling pond effluent will enter a manganese removal bed, 300' by 150' and finally into a polishing wetland, 200' by 100'.

The approximate cost of constructing the treatment system is $316,000 as a total for each of the components. Each VFW will cost $127,000 followed by the two settling ponds at $5,000 each. The manganese removal bed will cost $32,000 and $20,000 for the polishing wetland. An additional $10,000 will be added to construction costs for project oversight. These are estimated costs and could change at the time of construction. Additional costs are design and permitting. The typical costs can be broken down to surveying costs at $4,500, permitting costs at $3,900, E&S Controls at $1,560, Design and Engineering costs at $16,950, Bid Packages at $2,600, and Other/Project Management at $2,600. These are typical costs to design and permit a treatment site. They vary slightly depending on the size of the project. The total costs for design and permitting are therefore, $32,110. Miscellaneous costs of $20,000 are added for mobilization/demobilization, etc. Costs for road construction, liners, etc. would add to the project. The overall design and construction cost of Treatment Area #4 is $378,110. Again this treatment area may not be necessary if flows maintain at the 1-2 gpm level.

Predicted Effect of System on Receiving Stream:

The water discharging from the polishing wetland should be alkaline in nature with minimal iron and aluminum concentrations. The metals will be retained in the settling pond and wetland. The water discharging into Emigh Run will be able to support an aquatic community and will continue the neutralization of the main stem of Emigh Run.

Other:

A final O&M plan will be developed with the final design. Monthly flushing may be necessary of the VFW. High concentration of aluminum is present and regular flushing will insure the treatment cells do not plug from the amorphous precipitate. Additional maintenance will be removing precipitated metals from the settling pond. The ponds will be designed for a 15+ year lifespan. Visual checks of the system will be made monthly to insure that wildlife is not affecting the integrity of the system. A field monitoring plan will be established to determine the overall effects of the treatment system on water quality.

Permits will need to be obtained for the construction of the system. A field meeting will be conducted with PADEP, PGC, PFBC, Army Corp of Engineers, Conservation District, and NMBS to insure all permitting issues are addressed.

This project will be submitted to both the Growing Greener Program and the Chesapeake Bay Small Watershed Grants Program for design and permitting monies. The construction phase will be submitted to Growing Greener and potentially OSM for funding.

Other Projects, Priority Area 1: ER-30

A schematic of the treatment system proposed for this priority can be found on page C-12 in Appendix C.

ER-30 is a seepage area in the above described Section 2 of Emigh Run, below the power line. The seepage emanates in a wooded area and no source could be found. Access to the site will be difficult. The flow at this site is small, but it has a high concentration of iron that may need to be addressed.

Table 53: Summary of Chemistry ER-30

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	2.12	5.16	808	132	3.572	10.6	71.86	2.032	1.34	9.178	384.4
Max	3.1	5.6	1460	254	9.186	20	131	4.738	3.29	17.2	648
Min	1	4.6	539	76	1.398	6	50.5	0.674	0.21	6.4	233
75% Conf	2.543	5.377	979.2	164.416	5.035	13.274	87.403	2.803	1.943	11.257	457.817
90% Conf	2.726	5.471	1052.89	178.369	5.664	14.425	94.093	3.136	2.203	12.152	489.418

Recommendations:

The pH at this site averages 5.16, so a large wetland system is all that is necessary to treat the iron laden discharge. The flow where the seepage was collected averages only 2 gpm, but the iron concentration is 71.86 mg/L. The aluminum averages 1.34 mg/L with manganese averaging 9.18 mg/L. The primary goal of treatment will be to precipitate the iron before it enters the stream.

The treatment will consist of a 200' by 100' aerobic wetland with a 2:1 limestone to organic matter mixture to maintain the moderate pH levels as the iron precipitates. A settling pond will follow. Space and access are an issue at this site, so the conceptual design is minimal.

The approximate cost of constructing the treatment system is $40,000 as a total for each of the components. The aerobic wetland will cost $35,000 with an additional $5,000 for the settling pond. Miscellaneous costs for mobilization and demobilization, etc. are $10,000. Estimates of $12,500 for surveying, permitting and design are included. Costs for road construction, liners, etc. would add to the project. The overall design and construction cost of Other Area #2 is $62,500.

Predicted Effect of System on Receiving Stream:

The water discharging from the settling pond will have reduced iron concentrations. The metals will be retained in the settling pond and wetland. The water discharging into Emigh Run will be greatly improved from the iron laden seep and will continue to be neutralized from the upstream treatment having been constructed on Emigh Run.

Other:

A final O&M plan will be developed with the final design. Maintenance will be removing precipitated metals from the settling pond or replacing the organic layer in the aerobic wetland. The ponds will be designed for a 15+ year lifespan. Visual checks of the system will be made monthly to insure that wildlife is not affecting the integrity of the system. A field monitoring plan will be established to determine the overall effects of the treatment system on water quality.

Permits will need to be obtained for the construction of the system. A field meeting will be conducted with PADEP, PGC, PFBC, Army Corp of Engineers, Conservation District, and NMBS to insure all permitting issues are addressed.

This project will be submitted to both the Growing Greener Program and the Chesapeake Bay Small Watershed Grants Program for design and permitting monies. The construction phase will be submitted to Growing Greener and potentially OSM for funding.

Other Projects, Priority Area 2: ER-31

A schematic of the treatment system proposed for this priority can be found on page C-13 in Appendix C.

ER-31 is a seepage area which may not need to be addressed. There was no known source found for the seep. It emanates along the bank in a recently logged area. This is a seep that may be addressed when the other priorities in the watershed are complete.

Table 54: Summary of Chemistry ER-31

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	9.642	3.708	550.083	54.5	5.253	1.167	13.855	1.383	0.159	4.104	179.5
Max	35.1	5.3	1030	117	12.694	8	26.3	2.983	0.56	9.39	406
Min	2.2	3.1	141	4	0.121	0	0.36	0.011	0.09	0.15	52
75% Conf	12.628	3.934	635.492	65.216	6.463	2.043	16.482	1.71	0.201	4.992	210.37
90% Conf	13.913	4.031	672.255	69.828	6.984	2.421	17.612	1.851	0.219	5.374	223.658

Recommendations:

The pH at this site averages 3.71, with an acidity concentration of 54.5 mg/L. The flow where the seepage was collected averages 10 gpm, with an iron concentration of 13.86 mg/L. The aluminum averages 0.16 with manganese averaging 4.10 mg/L. The primary goal of treatment will be to precipitate the iron before it enters the stream.

The treatment will consist of a 100’ by 50’ VFW with 300 tons of limestone. It will discharge to a settling pond to precipitate the iron. A polishing wetland, 200’ by 100’ will be added to increase the pH and precipitate any remaining metals. The wetland will be constructed with a 2:1 organic matter to limestone substrate.

The approximate cost of constructing the treatment system is $45,000 as a total for each of the components. The VFW will cost $20,000 with an additional $5,000 for the settling pond. The polishing wetland will cost $20,000. Miscellaneous costs for mobilization and demobilization, etc. are $10,000. Estimates of $18,500 for surveying, permitting and design are included. Costs for road construction, liners, etc. would add to the project. The overall design and construction cost of Other Area #3 is $73,500.

Predicted Effect of System on Receiving Stream:

The water discharging from the settling pond will have reduced iron concentrations. The metals will be retained in the settling pond and wetland. The water discharging into Emigh Run will be greatly improved from the iron seep and will continue to be neutralized from the upstream treatment having been constructed on Emigh Run.

Other:

A final O&M plan will be developed with the final design. Maintenance will be removing precipitated metals from the settling pond or replacing the organic layer in the wetland. The ponds will be designed for a 15+ year lifespan. Visual checks of the system will be made monthly to insure that wildlife is not

affecting the integrity of the system. A field monitoring plan will be established to determine the overall effects of the treatment system on water quality.

Permits will need to be obtained for the construction of the system. A field meeting will be conducted with PADEP, PGC, PFBC, Army Corp of Engineers, Conservation District, and NMBS to insure all permitting issues are addressed.

This project will be submitted to both the Growing Greener Program and the Chesapeake Bay Small Watershed Grants Program for design and permitting monies. The construction phase will be submitted to Growing Greener and potentially OSM for funding.

Other Projects, Priority Area 3: ER-36

A schematic of the treatment system proposed for this priority can be found on page C-14 in Appendix C.

ER-36 is an iron seep located directly along the stream bank. There is no room for treatment, but it may be possible to excavate an area for a settling pond with enhanced aeration techniques to precipitate the iron before it enters Emigh Run.

Table 55: Summary of Chemistry ER-36

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	3.573	3.792	1447.583	173.083	7.885	2.167	73.721	3.573	0.083	15.348	649.583
Max	20	5.3	1870	218	51.595	8	175	25.074	0.27	21.7	887
Min	0.5	3	514	34	1.221	0	7.75	0.175	0.03	3.26	168
75% Conf	5.254	4.05	1583.415	194.226	12.341	3.224	89.671	5.766	0.104	17.305	722.328
90% Conf	5.978	4.161	1641.882	203.327	14.259	3.679	96.536	6.71	0.114	18.147	753.639

Recommendations:

Due to the limited space available the only recommendation is for the construction of a settling pond. The flow averages 4 gpm, but with an average iron concentration of 73.72 mg/L. The pH is relatively low, averaging 3.79, so a concern about the continued precipitation of the iron exists. It may be possible to add limestone to a collection ditch to slightly increase the pH. A semi-passive approach may be to add powdered lime to the settling pond to be mixed in with the aeration techniques.

An estimated cost of $25,000 is given for this Other Area #4. If lime is used on a regular basis, increased costs may exist for the stock piling of the lime. Cost may also vary on the aeration technique employed. An additional $10,000 will be added for miscellaneous cost, for a total project cost of $35,000.

Predicted Effect of System on Receiving Stream:

The water discharging from the settling pond should be alkaline in nature with minimal iron and aluminum concentrations. The metals will be retained in the settling pond and wetland. The water discharging into Emigh Run will be able to support an aquatic community and will continue the neutralization of the main stem of Emigh Run.

Other:

A final O&M plan will be developed with the final design. Maintenance will be removing precipitated metals from the settling pond. The ponds will be designed for a 15+ year lifespan. Other maintenance may be the addition of lime material to the settling pond. Visual checks of the system will be made

monthly to insure that wildlife is not affecting the integrity of the system. A field monitoring plan will be established to determine the overall effects of the treatment system on water quality.

Permits will need to be obtained for the construction of the system. A field meeting will be conducted with PADEP, PGC, PFBC, Army Corp of Engineers, Conservation District, and NMBS to insure all permitting issues are addressed.

This project will be submitted to both the Growing Greener Program and the Chesapeake Bay Small Watershed Grants Program for design and permitting monies. The construction phase will be submitted to Growing Greener and potentially OSM for funding.

Other Projects, Priority Area 4: ER-39

A schematic of the treatment system proposed for this priority can be found on page C-15 in Appendix C.

ER-39 is a small tributary entering from the left side working downstream. It flows through the area to be mined by King Coal. It has slightly degraded water quality, but upon further investigation no discrete source of pollution could be found. The water quality can most likely be blamed on the overall geology of the area and the extensive historical mining.

Table 56: Summary of Chemistry ER-39

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	238.073	4.525	464.083	33.667	97.19	5.75	1.052	4.749	4.148	3.667	175
Max	550	4.8	605	58	302.768	8	6.72	44.555	6.51	5.13	258
Min	12.7	4.3	261	10	5.511	3	0.17	0.355	2	1.63	81
75% Conf	296.844	4.574	494.253	37.864	126.352	6.241	1.65	9.116	4.65	3.984	189.64
90% Conf	322.141	4.595	507.239	39.671	138.904	6.452	1.907	10.996	4.867	4.121	195.942

Recommendations:

Treating the tributary through passive treatment measures is not recommended. The flow averages 240 gpm, with an average iron concentration of 1.05 mg/L. The pH is marginal, averaging 4.5, with low levels of aluminum and manganese. A semi-passive approach, lime sand addition, may be useful to boost the pH and add alkalinity. Mining activities by King Coal and the addition of lime to their backfill may also improve the overall water quality. The tributary will be revisited for final recommendations after mining activities are complete.

An estimated cost of $5,000 per year for lime addition is included for calculation purposes.

Other Projects, Priority Area 5: ER-45

A schematic of the treatment system proposed for this priority can be found on page C-16 in Appendix C.

ER-45 is a diffuse flow, iron laden seep. It is included in the Other projects because of the difficulty in access to the site. No flow device was installed because of the diffuse flow, so only estimates of flow were made. This site is similar to ER-40 and the other large iron mats on the right side of Emigh Run working downstream.

Table 57: Summary of Chemistry ER-45

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
Ave	30	5.9	1682.727	130.545	50.811	0	84.218	15.326	0.353	16.618	851.909
Max	50	32	2080	179	96.438	0	438	26.581	1.17	18.9	1235
Min	15	3	580	80	25.858	0	34.3	9.059	0.09	10.2	504
75% Conf	39.773	8.762	1834.991	140.475	72.264	0	123.151	20.621	0.455	17.471	922.12
90% Conf	43.98	9.995	1900.531	144.749	81.498	0	139.908	22.9	0.5	17.838	952.341

Recommendations:

A collection ditch will be used to capture the flow into one discrete location and additional water quality analysis and flow measurements will be conducted to insure accurate final design. The estimated flow was 30 gpm. The acidity concentration is 130.55 mg/L with iron averaging 84.22 mg/l, but minimal aluminum at 0.35 mg/L. Manganese averages 16.62 mg/L. The primary goal of treatment will be to precipitate the iron before it enters the stream.

Due to the lower pH at this site, averaging 3.4, a buried ALD, 100’ by 25’ with 500 tons of limestone, may be used to increase the pH for iron precipitation in the settling pond. Dissolved oxygen measurements will be collected to determine if this is a feasible approach. The ALD will flow into a settling pond to allow the iron to precipitate. Aeration techniques will be included in this design. This is a simplest conceptual design that may be employed. If access and space is available, additional wetlands may be added.

The approximate cost of constructing the treatment system is $25,000 as a total for each of the components. The ALD will cost $15,000 to construct, followed by the settling pond at $10,000. An additional $10,000 will be added for miscellaneous costs. These are estimated costs and could change at the time of construction. The cost for engineering work, design, and permitting are estimated at $18,500. Costs for road construction, liners, etc. would add to the project. The overall design and construction cost of Other Area #6 is $53,500.

Predicted Effect of System on Receiving Stream:

The water discharging from the settling pond will have reduced iron concentrations. The metals will be retained in the settling pond and wetland. The water discharging into Emigh Run will be greatly improved from the iron seep and will continue to be neutralized from the upstream treatment having been constructed on Emigh Run.

Other:

A final O&M plan will be developed with the final design. Maintenance will include removing precipitated metals from the settling pond. The pond will be designed for a 15+ year lifespan. Visual checks of the system will be made monthly to insure that wildlife is not affecting the integrity of the system. A field monitoring plan will be established to determine the overall effects of the treatment system on water quality.

Permits will need to be obtained for the construction of the system. A field meeting will be conducted with PADEP, PGC, PFBC, Army Corp of Engineers, Conservation District, and NMBS to insure all permitting issues are addressed.

This project will be submitted to both the Growing Greener Program and the Chesapeake Bay Small Watershed Grants Program for design and permitting monies. The construction phase will be submitted to Growing Greener and potentially OSM for funding.

Summary Treatment Areas

The following table summarizes the treatment necessary for the restoration of Emigh Run. Seven priority treatment areas have been identified, along with four additional sites that may need to be addressed when King Coal has completed its remining and reclamation activities within the watershed; an additional five small treatment areas have also been identified as ones that are worth reviewing after the initial priority projects have been constructed. The table lists the type of treatment to be used and the cost associated with each area. The best available technology at the time will be used and treatment designs may be changed upon further site investigation. These are conceptual designs only.

Considerations will be taken into all final designs. Flushing systems will be a priority and concern, especially at treatment areas where high aluminum levels are present. The incorporation of new designs being developed by BAMR for upflow limestone ponds using a water level activated flushing system may be used. Our vertical flow systems may incorporate the two-tiered approach to flushing to insure the top 6” of limestone does not become plugged with aluminum. By-pass systems will be used in all treatment areas to allow excess flow to by-pass the system, instead of short circuiting or decreasing the longevity of the system. The by-pass system will consist of limestone channels to provide some treatment to the excess flow. The VFWs will incorporate at least 24 inches of organic matter to insure the long-term viability of a bacterial community which should act to reduce iron and add alkalinity to the system. The piping system will be designed in a grid like pattern to insure flow throughout the system and decrease the chance of preferential flow. In-flow will be distributed through a perforated pipe on the horizontal surface of the VFW to insure flow throughout the system. The aerobic wetlands will be constructed with a combination of organic material and limestone to increase alkalinity production and longevity of the compost layer. This will insure the bacterial community is able to thrive and act as sulfate reducers through the lifetime of the system.

Table 58: Summary of Treatment Areas

Priority	Sites	Treatment	Cost
#1	ER-1, SPRING	Natural Stream Channel Design	$79,460
#2	ER13, ER-14	VFW, Wetlands	$276,110
#3	ER-8	Upflow Pond, Wetland	$68,500
#4	ER-32	VFW, Wetlands	$147,310
#5	ER-35	VFW, Wetlands	$312,110
#6	ER-40	ALD, VFW, Wetlands	$189,110
#7	ER-44	VFW, Wetlands	$282,110
King Coal #1	ER-6	VFW, Mn Removal Beds, Wetlands	$236,110
King Coal #2	ER-9	Wetlands, Limestone Pond, Mn Removal Beds	$230,110
King Coal #3	ER-10	Wetlands, Limestone Pond, Mn Removal Beds	$237,110
King Coal #4	ER-12	VFW, Mn Removal Beds, Wetlands	$378,110
Other #1	ER-30	Wetlands	$62,500
Other #2	ER-31	VFW, Wetland	$73,500
Other #3	ER-36	Aeration Pond	$35,000
Other #4	ER-39	Lime Sand Addition	$5,000/yr
Other #5	ER-45	ALD, Aeration Pond	$53,500

Priority of Reclamation Areas:

Table 59: Estimated Reclamation Costs of Priority #1 at ER-32

Item	Cost
Regrading $4,000/acre	$40,000
Revegetating/mulching/seeding $1,000/acre	$10,000
Lime addition @ 20 tons/acre $520/acre	$5,200
Total	$55,200

Potential Funding Sources

As used in the past, PADEP's Growing Greener Program is considered the largest source of funding for watershed projects. This program funded the development of this restoration plan, and the design and permitting for Priority Area #2. This program provides funding for design/permitting and construction phases for remediation of mine drainage in a watershed. The grant period normally opens in early winter and closes in early spring, with announcements made in late summer. The grant length is normally two to three years to allow for completion of construction. Non-profit groups, educational institutions and municipalities may apply for grants. Through submission to the Growing Greener Grant program, projects are eligible for EPA 319 Watershed grants. To be eligible for EPA 319 monies, a TMDL needs to be completed on the watershed.

Another source of funding is through the Chesapeake Bay Small Watershed Grants Program. The grant deadline is in February and grants are awarded in late summer. Funding has been secured through this program for the design and permitting of Priority Area #1. Any watershed activity is eligible for funding, but the grants are limited to $50,000 and require up to 50% match. This program can be used successfully for design and permitting, but construction activities are normally out of this range.

A final source of funding is through the Office of Surface Mining Appalachian Clean Streams Initiative. These grants can be used for construction phases only, not for engineering or design costs. This program also requires a significant match. These grants are within the $100,000 range, but can be successfully matched with other funding to complete a project. OSM has an open grant application, so no deadlines exist. Meetings have occurred for the construction phase of Priority Area #1 and formal submission of a grant application will occur in the Spring of 2005.

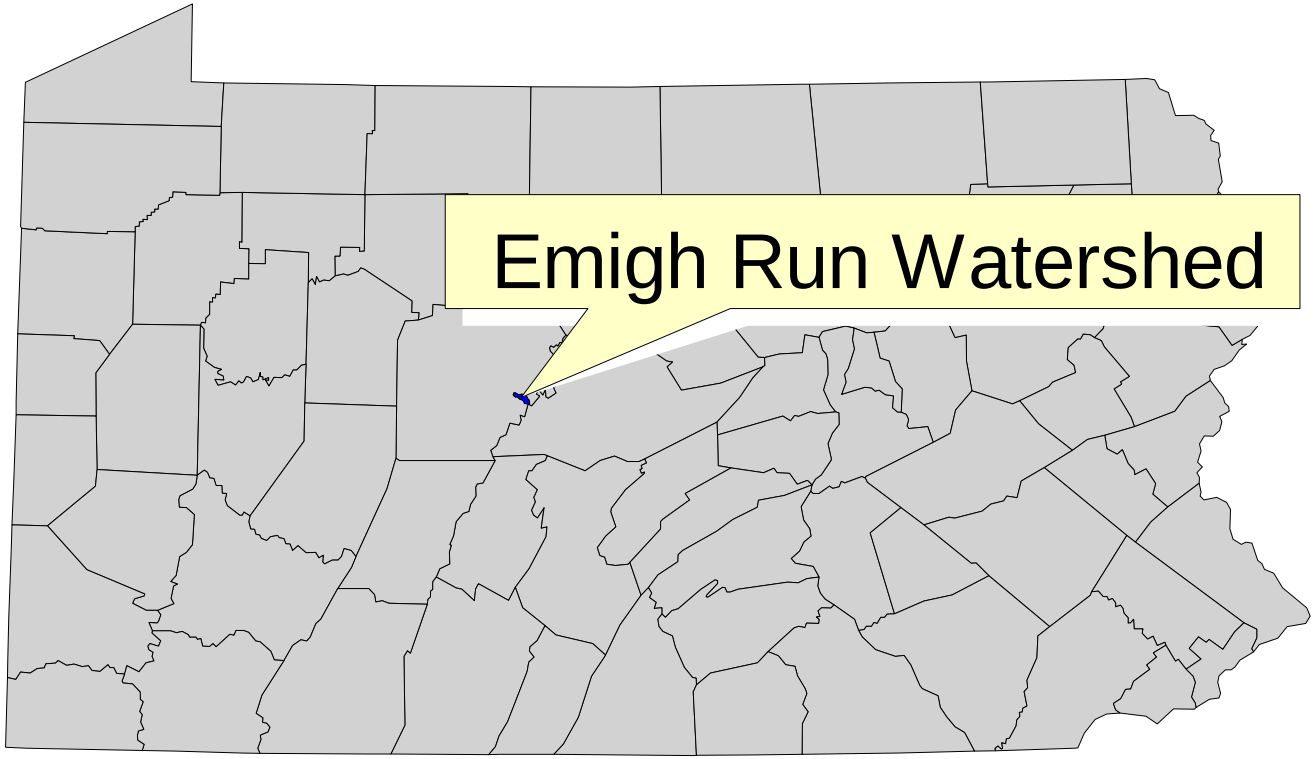
As stated above, all grant programs rely on match money for success and funding. This match comes through community involvement, volunteers, equipment donation, or material donation. For work conducted in the Emigh Run Watershed, support and partnerships of Boggs and Morris Townships, ERLWA and the West Branch Area School District can be used as a match. All partners have committed to man hours for building of roads, ditch construction, and long term maintenance. It is these types of partnerships that make projects a success.

Appendix A: Maps

Page	Map name	Description
A-2	Emigh Run Watershed in PA	This displays a map of Pennsylvania and displays the location of the Emigh Run Watershed within the Commonwealth.
A-3	Civil boundaries	This map displays the Emigh Run watershed in the context of the surrounding municipalities.
A-4	Stream Quality	This displays a color coded version of Emigh Run. The variation in color describes the quality of the stream as it runs from headwaters to mouth (based upon the sampling which was done).
A-5	Mined Areas	This map displays the Emigh Run watershed and the position of underground and other permitted mining operations within or near the watershed boundary.
A-6	Monthly Sampling on Topo	This displays the Emigh Run watershed, parts of the surrounding streams, and the position of monthly sampling points. Relevant portions of the USGS quad maps for the area are also displayed on this map.
A-7	Monthly Sampling - Section 1	This displays the Emigh Run watershed, parts of the surrounding streams, and the position of monthly sampling points. Monthly samples were not all sampled each month for a variety of reasons, but the points listed here were intended to be sampled monthly. See the table summarizing all points to see the number of months during which each point was actually sampled. For a view of points sampled during this study which were sampled less than eight times, see map A-15. Detailed sections are broken up for display purposes only. Areas were selected to allow reasonable grouping for viewing purposes.
A-8	Section 2	
A-9	Section 3	
A-10	Historical Sampling Overview	This displays the Emigh Run watershed, parts of the surrounding streams, and the historical sampling points. Detailed sections are broken up for display purposes only. Areas were selected to allow reasonable grouping for viewing purposes.
A-11	Section 1	
A-12	Section 2	
A-13	Section 3	
A-14	Section 4	
A-15	Sampled Points	This displays the Emigh Run watershed, parts of the surrounding streams, and points sampled infrequently (less than eight times) as part of this study. This includes quarterly and grab samples taken at some point during the study.
A-16	Treatment Areas	This displays the proposed treatment areas against the boundary of the Emigh Run Watershed.
A-17	Treatment Areas on Topo	This displays the proposed treatment areas against the boundary of the Emigh Run Watershed. Relevant portions of the USGS quad maps for the area are also displayed on this map.
A-18	Soil Survey	This graph shows the dominant soils in the watershed. The soils identified on this map are discussed in the text. Please realize that “vacant” areas actually contain multiple soil types and the display of these types is omitted to allow for a more readable map and legend.
A-19	Geology	A geological survey map of Clearfield County.

Maps should be used as reference only. Exact precision is neither implied nor guaranteed.

Emigh Run Watershed in PA



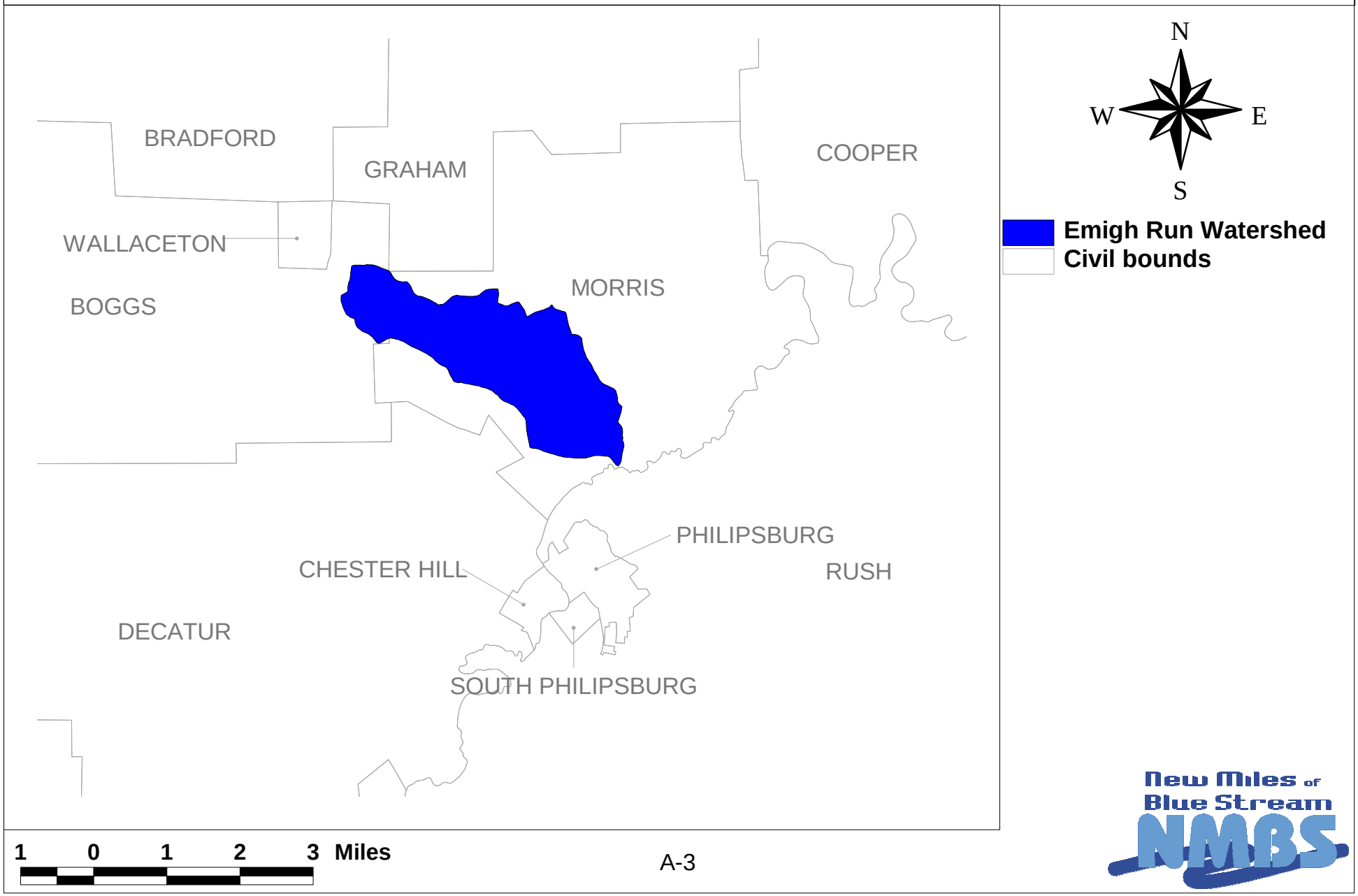
N
W E
S

Emigh Run Watershed
County Bounds

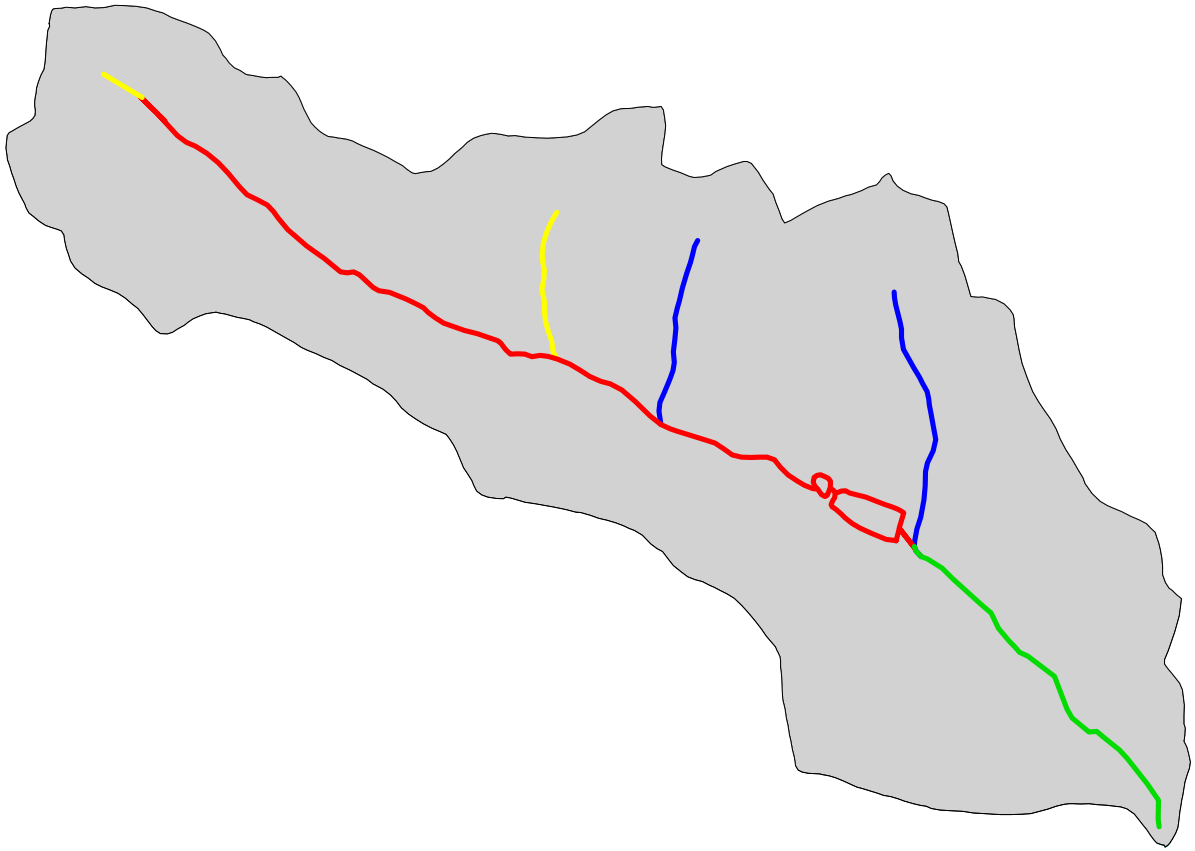
30 0 30 60 90 **Miles**

New Miles of Blue Stream
NMBS

Civil Boundaries



Stream Quality



N
W E
S

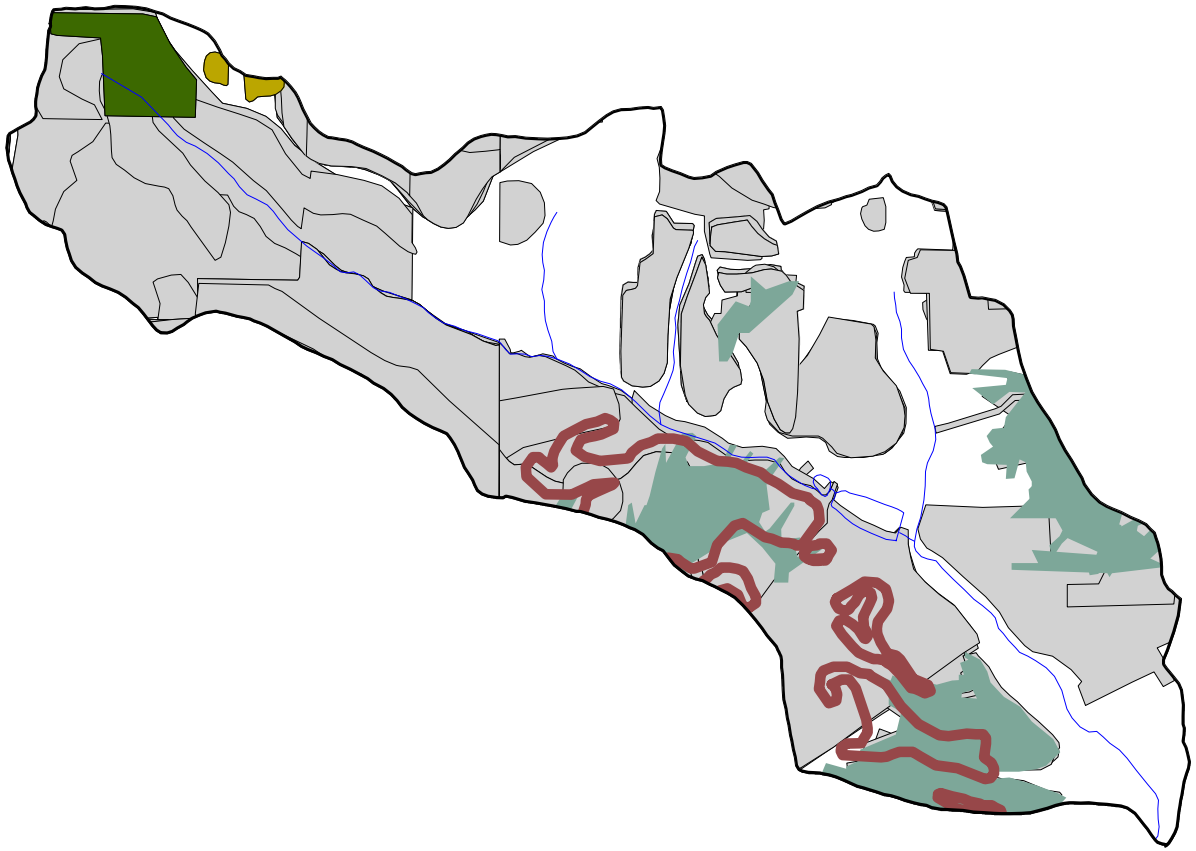
Stream Quality

- Highly Degraded
- Moderately Degraded
- Slightly Degraded
- High Quality
- Not Specified
- Watershed

0.4 0 0.4 0.8 1.2 Miles

New Miles of Blue Stream NMBS

Mined Areas



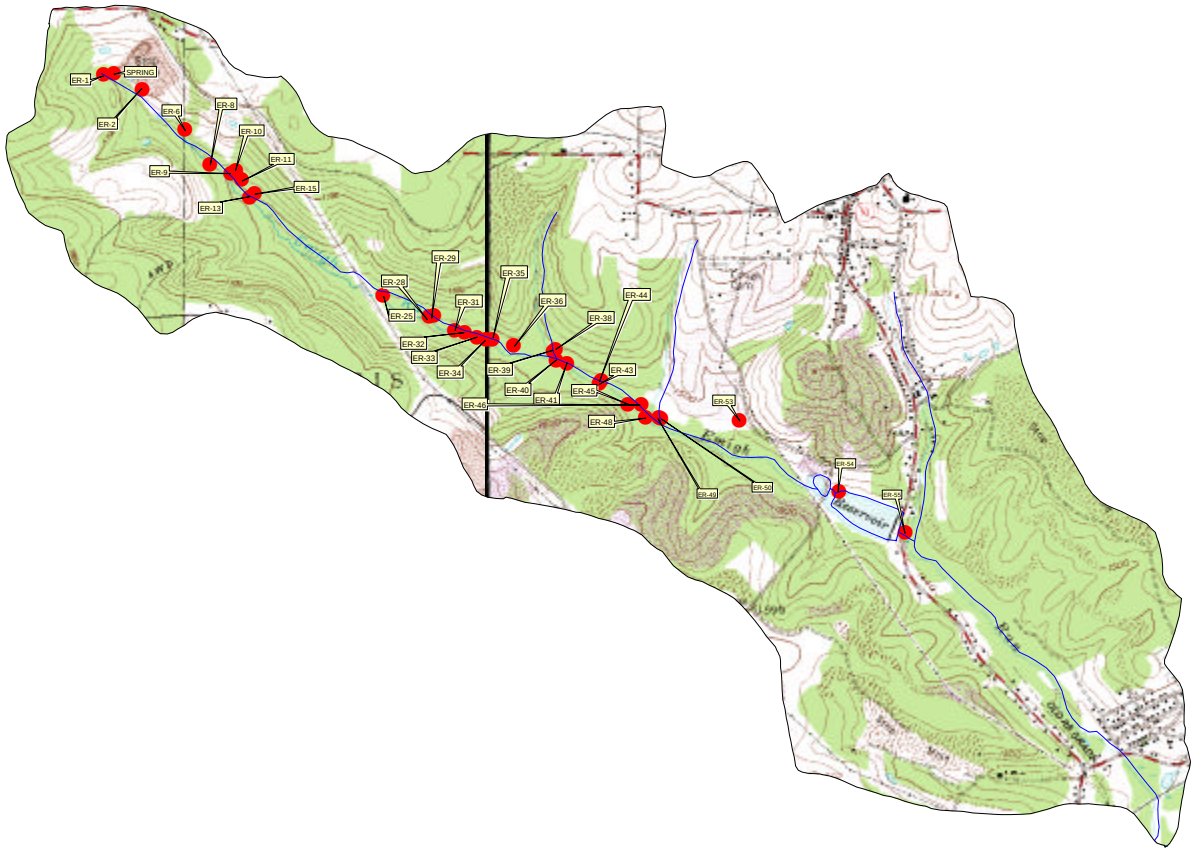
N
W E
S

Watershed
Reclamation Areas
Graham Bros
Avery Tipple
Mined (Scarllift)
Mined (Mine Maps)
Permitted

0.4 0 0.4 0.8 1.2 Miles

New Miles of Blue Stream
NMBS

Monthly Sampling on Topo



N

W E

S

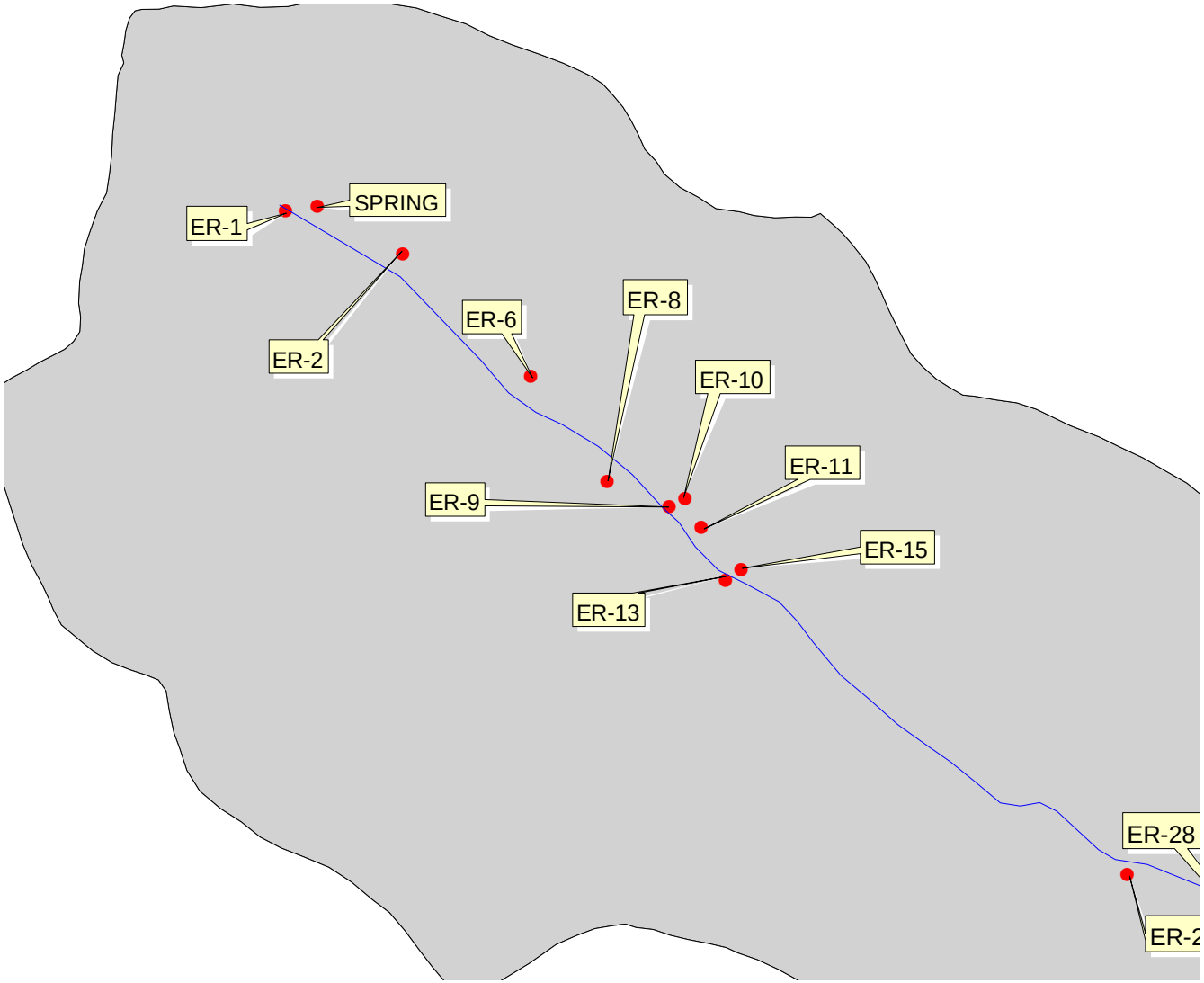
Sampled

- **> 7 times**

0.4 0 0.4 0.8 1.2 Miles

New Miles of Blue Stream NMBS

Monthly Sampling (s1)



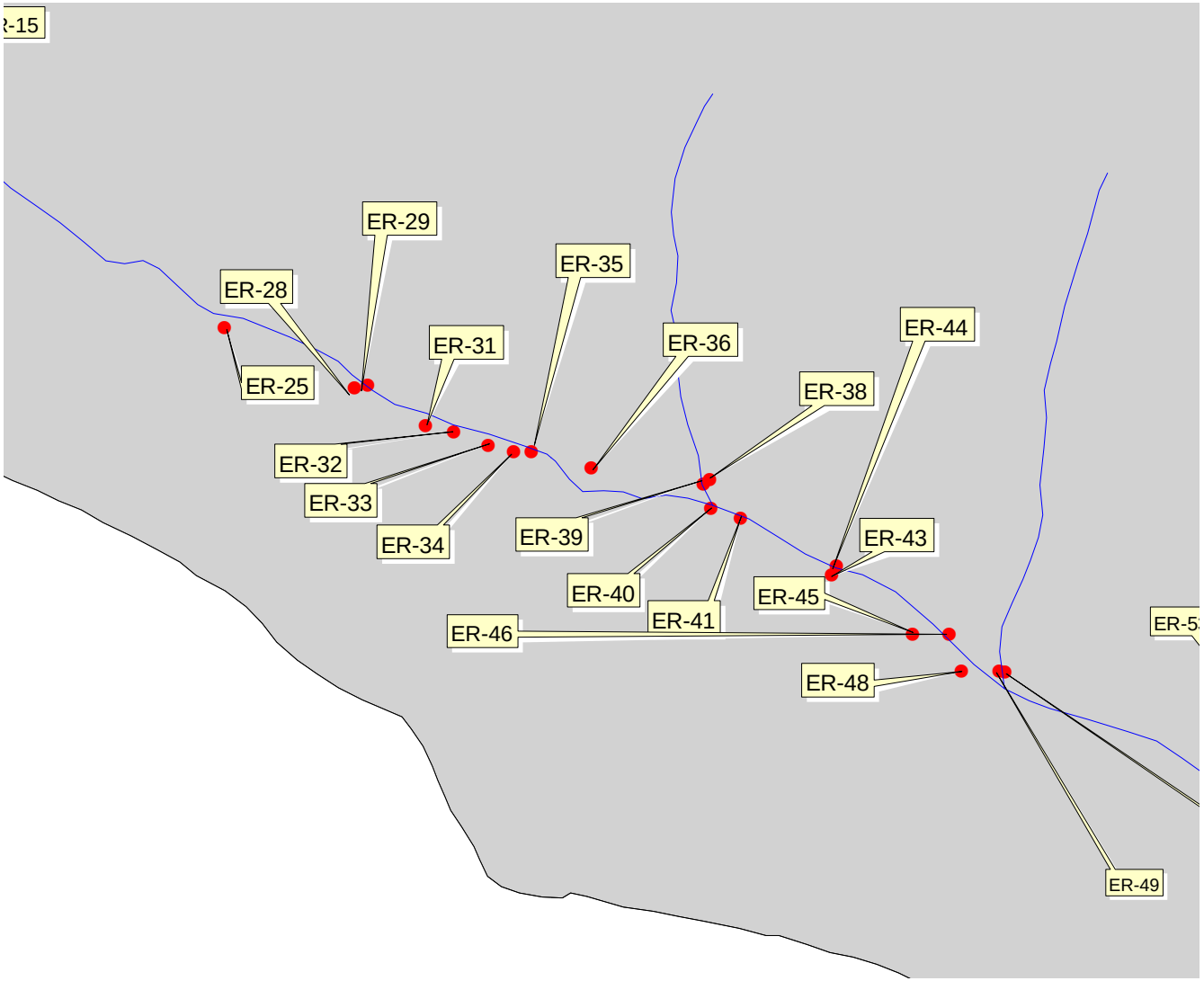
N
W E
S

Sampled

- **> 7 times**

0.1 0 0.1 0.2 0.3 Miles

Monthly Sampling (s2)



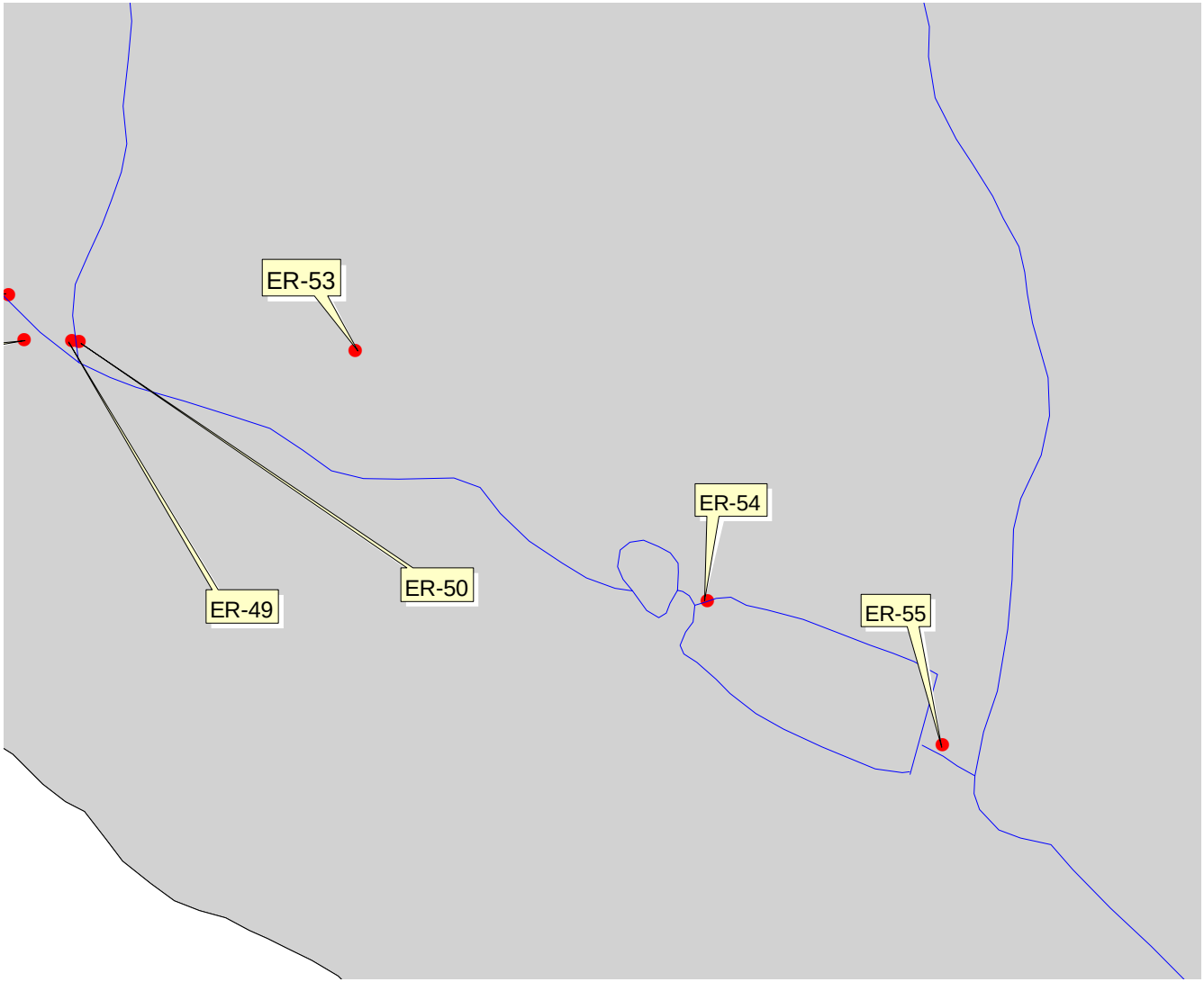
N
W E
S

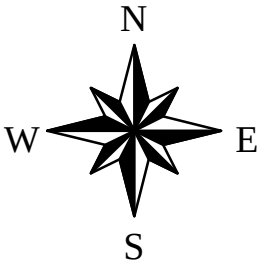
Sampled

- **> 7 times**

0.1 0 0.1 0.2 0.3 Miles

Monthly Sampling (s3)



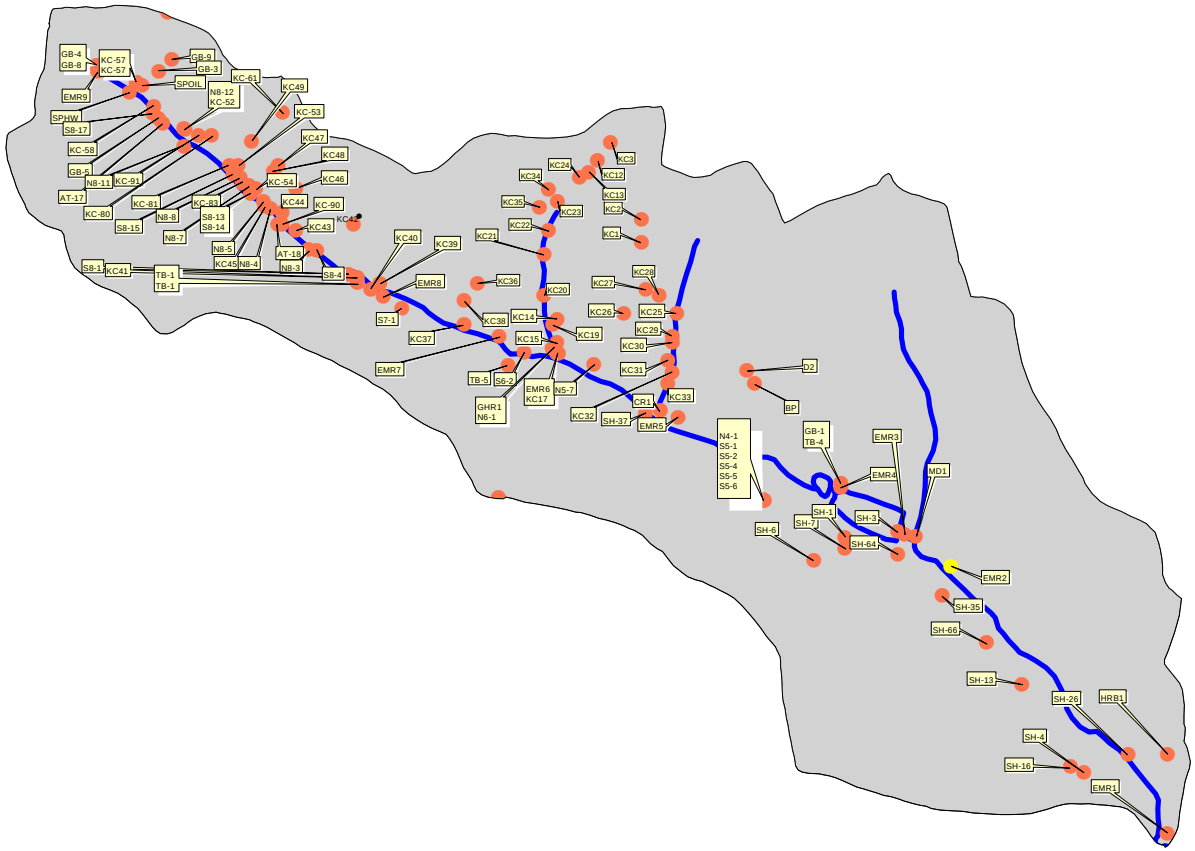


Sampled

- **> 7 times**

0.08 0 0.08 0.16 0.24 Miles

Historical Sampling



N

W E

S

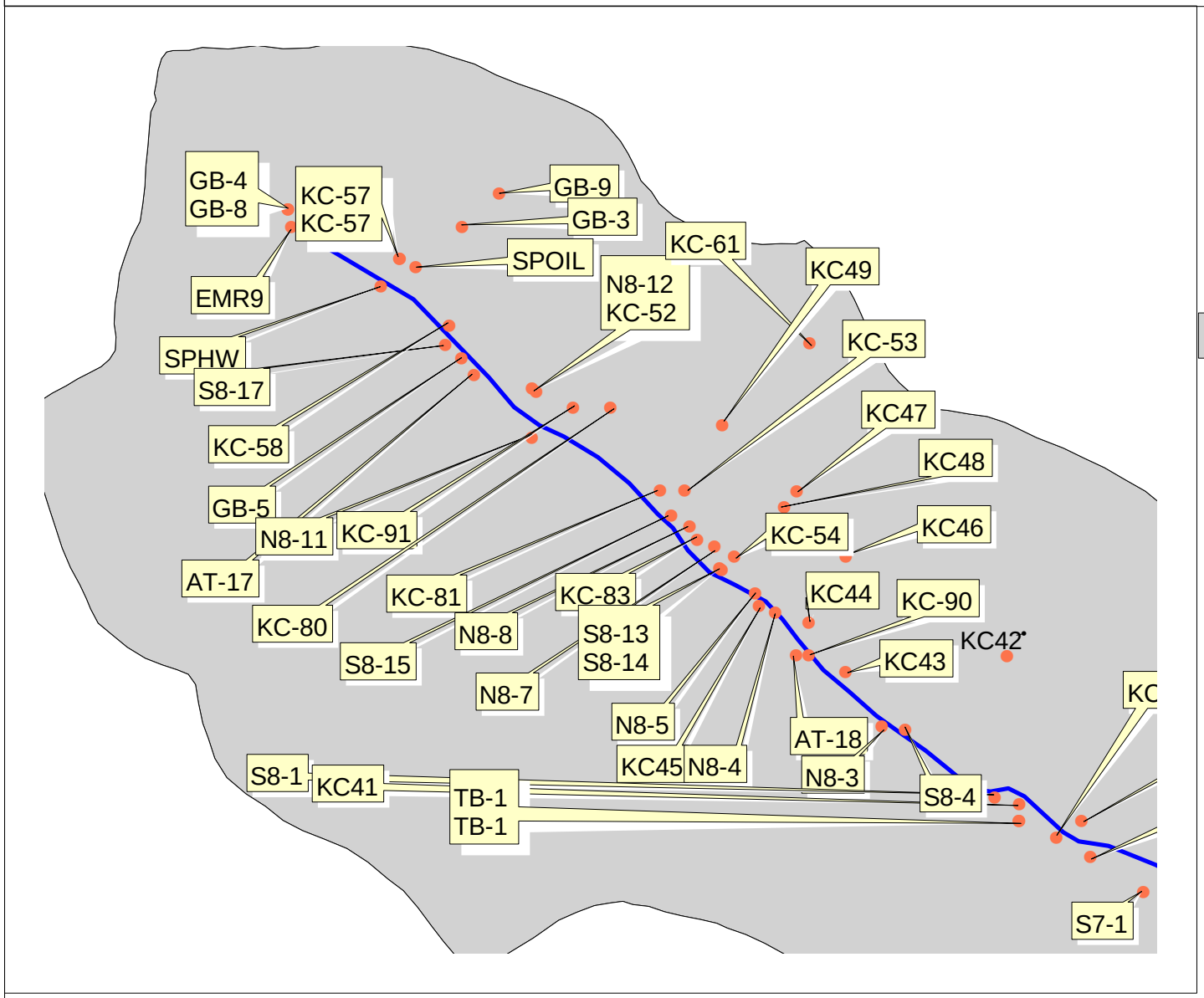
Historical pts

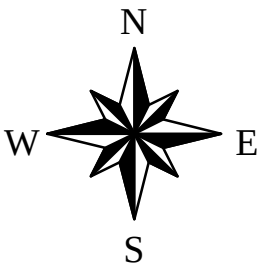
Watershed

0.4 0 0.4 0.8 1.2 Miles

New Miles of Blue Stream NMBS

Historical Sampling (s1)



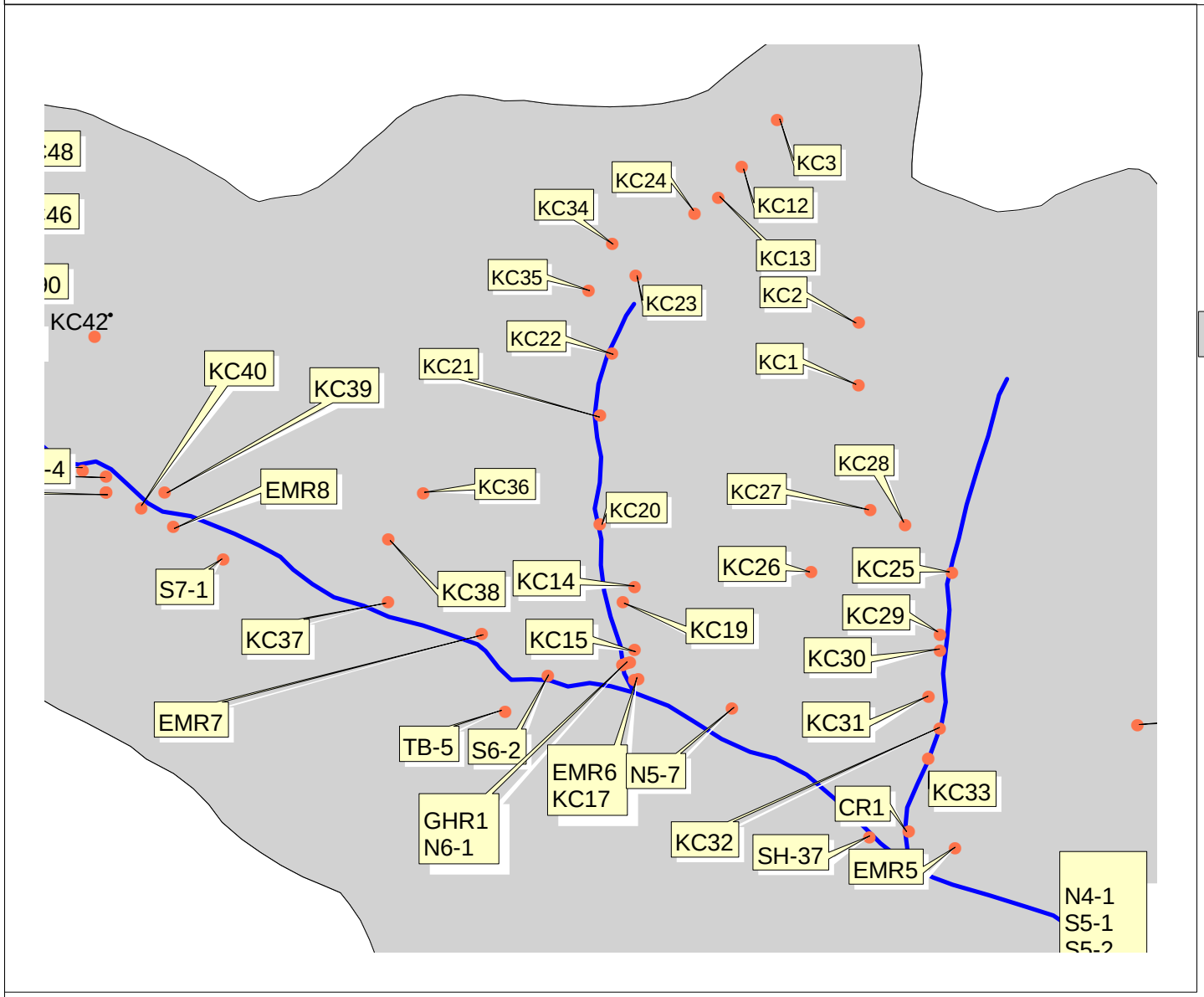


Historical pts

Watershed

0.1 0 0.1 0.2 0.3 Miles

Historical Sampling (s2)



N
W
E
S

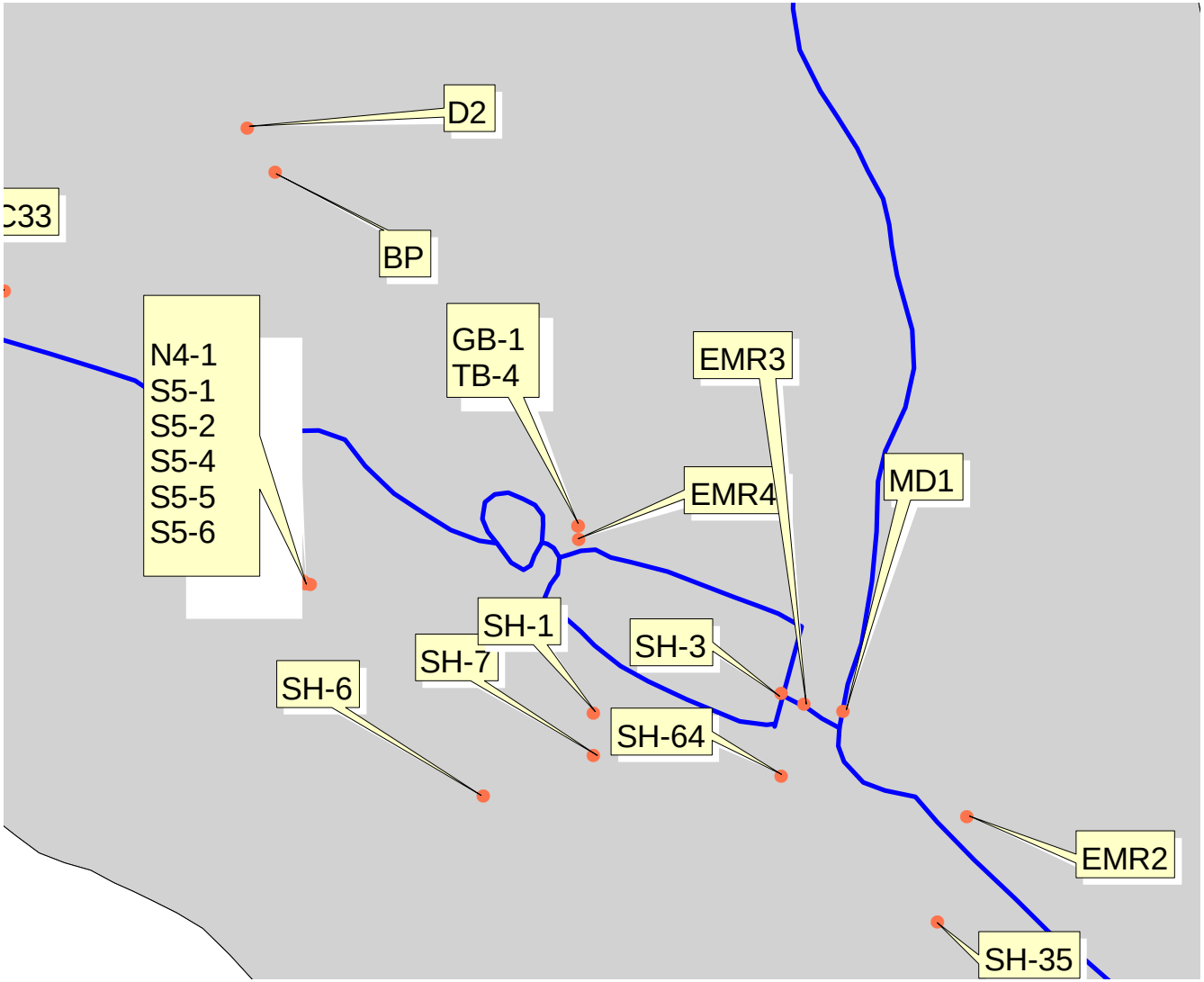
Historical pts

Watershed

0.1 0 0.1 0.2 0.3 Miles

New Miles of Blue Stream NMBS

Historical Sampling (s3)



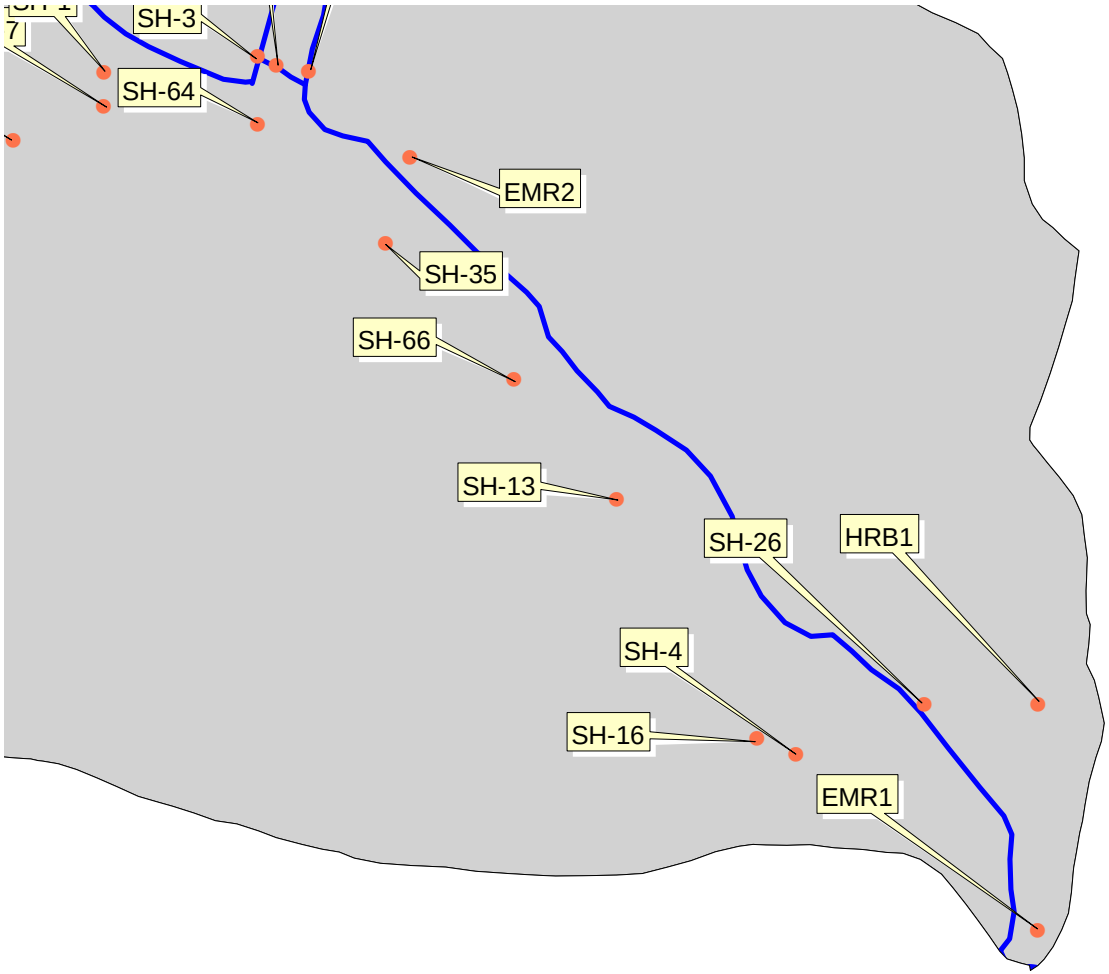
N
W E
S

Historical pts
Watershed

0.08 0 0.08 0.16 0.24 Miles

New Miles of Blue Stream NMBS

Historical Sampling (s4)



N
W E
S

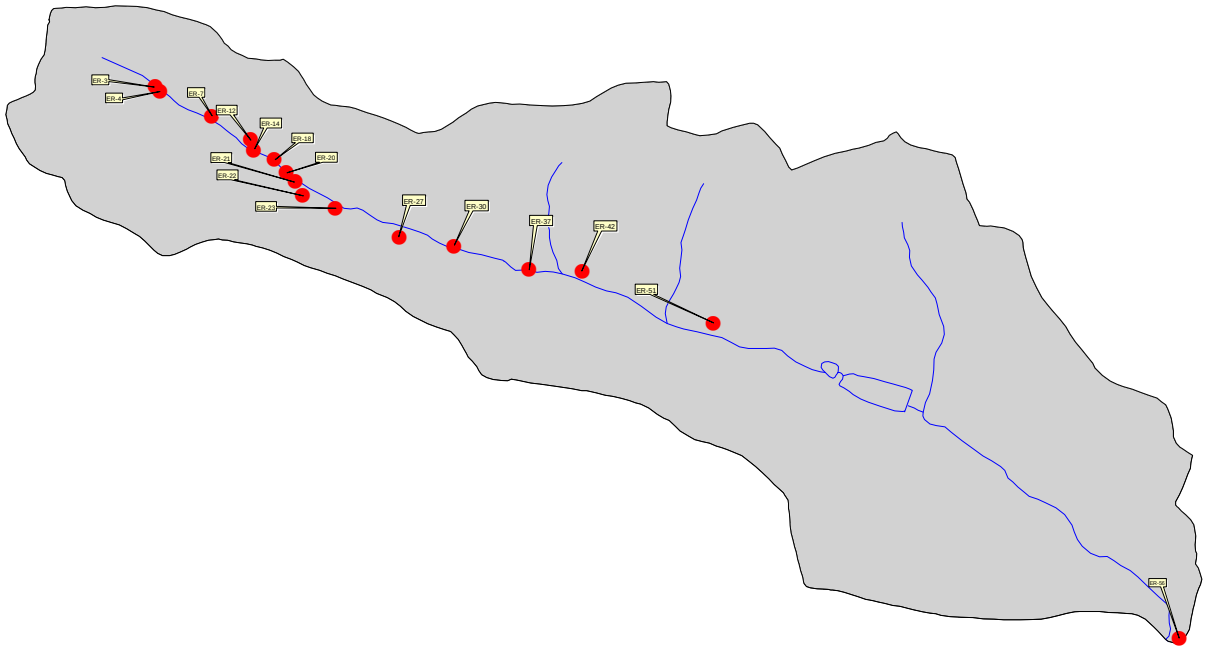
Historical pts
Watershed

0.1 0 0.1 0.2 0.3 Miles

New Miles of Blue Stream NMBS

Sampled Points

(not on Monthly map)



N

W E

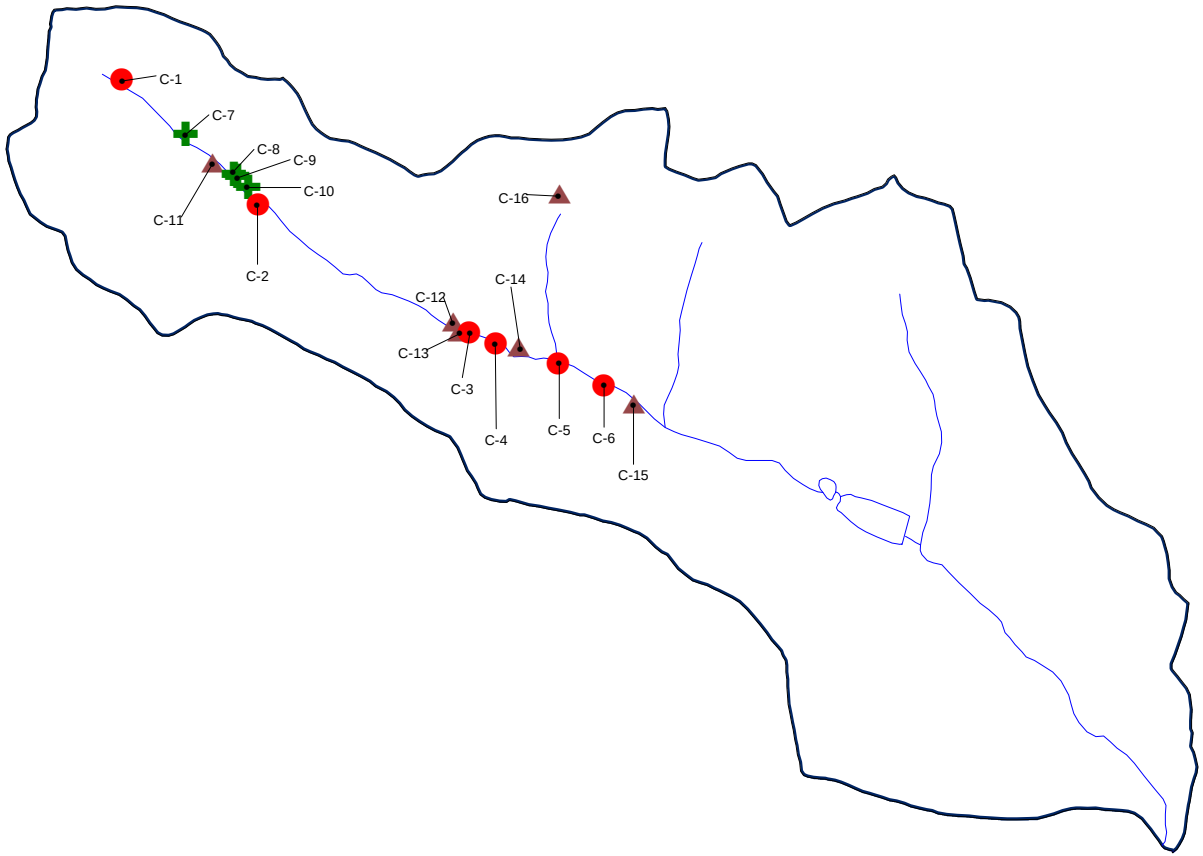
S

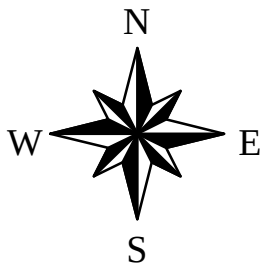
Sampled

- **Periodic**

0.5 0 0.5 1 1.5 Miles

Treatment Systems



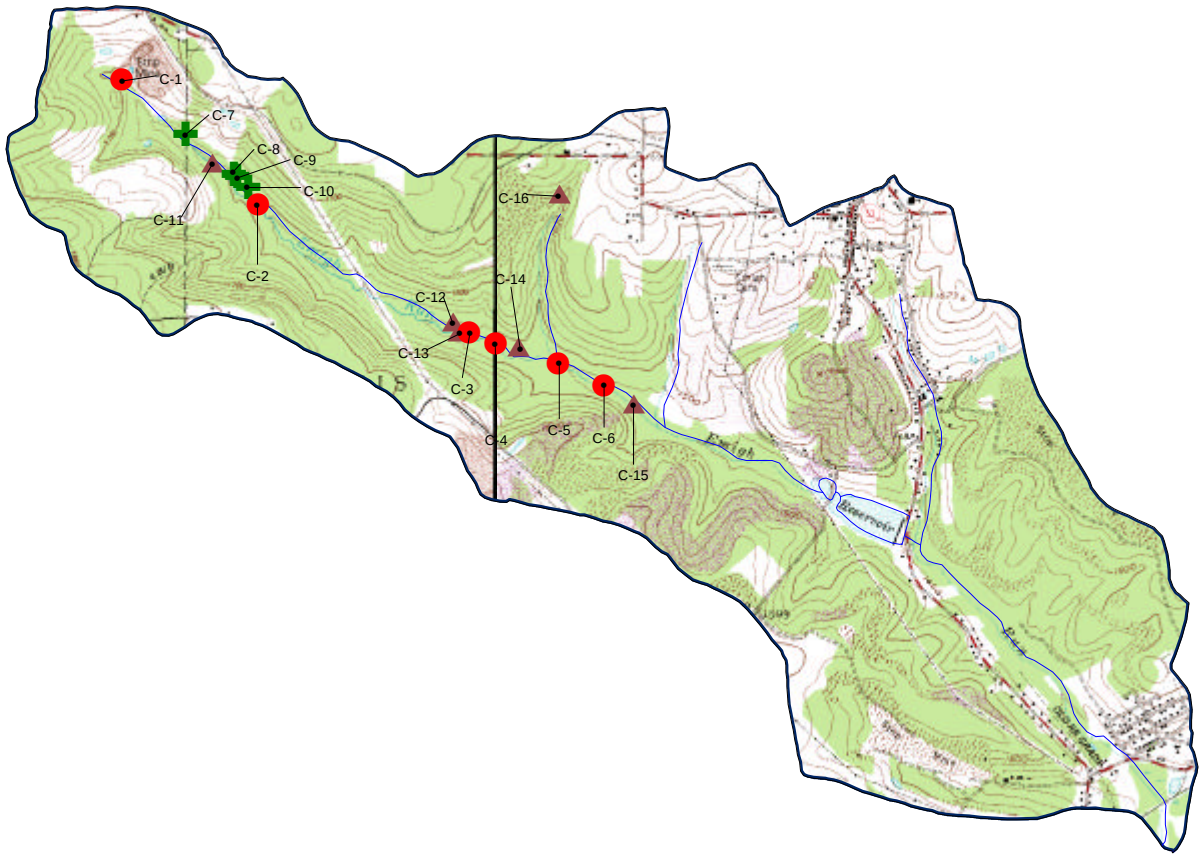


Treatment Area

- Priority
- King Coal
- Other

0.4 0 0.4 0.8 1.2 Miles

Treatment Systems on Topo



N
W E
S

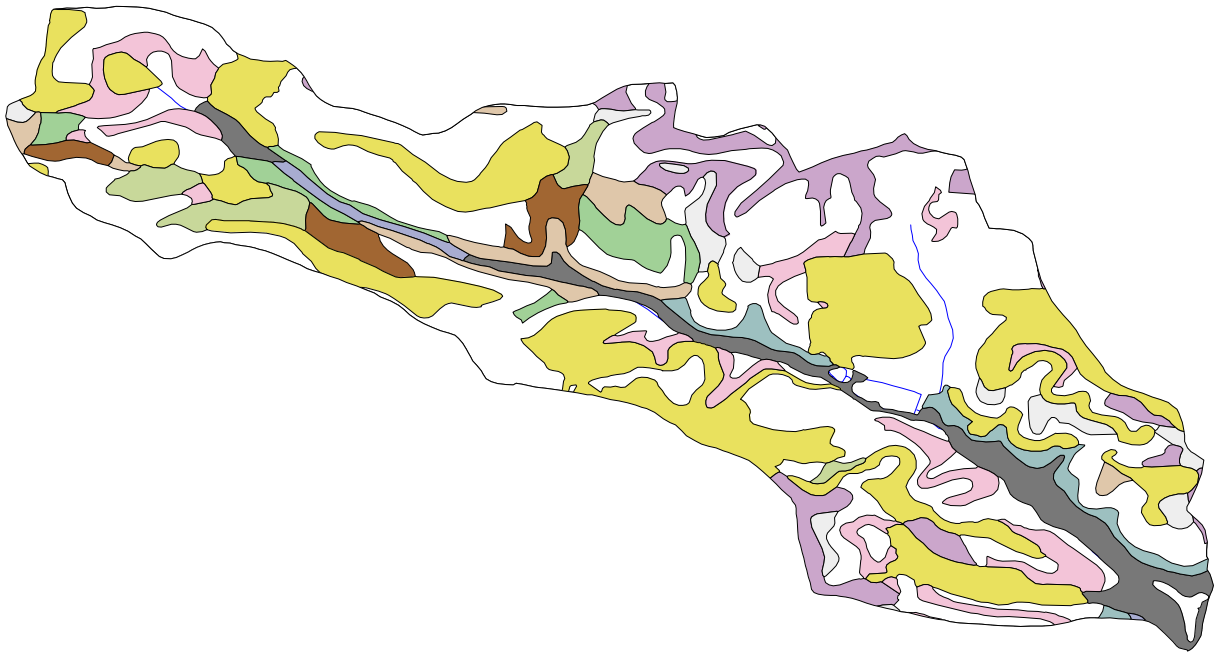
Treatment Area

- Priority
- King Coal
- Other

0.4 0 0.4 0.8 1.2 Miles

New Miles of Blue Stream NMBS

Dominant Soils



N
W E
S

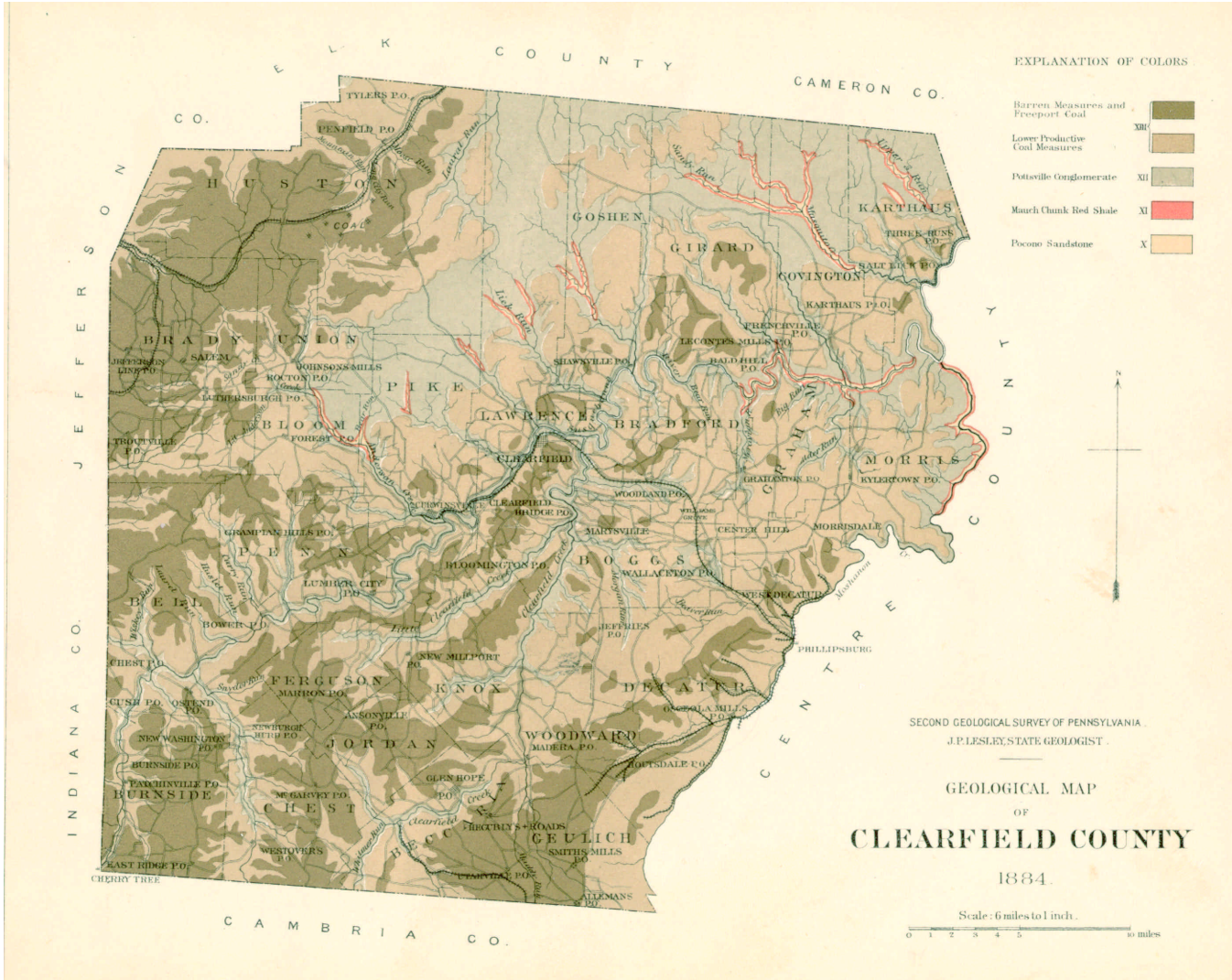
Soil Types

- At
- BrB
- CoB
- CoC
- Erc
- GlB
- HbF
- Ph
- RbF
- RcD
- Uo
- WhB
- Watershed

0.5 0 0.5 1 1.5 Miles

New Miles of Blue Stream NMBS

Geology


ELK COUNTY
CAMERON CO.
JEFFERSON CO.
INDIANA CO.
CAMBRIA CO.
CENTRE COUNTY
EXPLANATION OF COLORS
Barren Measures and Freeport Coal
Lower Productive Coal Measures
Pottsville Conglomerate
Mauch Chunk Red Shale
Pocono Sandstone
HUSTON
GOSHEN
GIRARD
KARTHAUS
COVINGTON
BRADY
UNION
PIKE
BLOOM
LAWRENCE
BRADFORD
GRAHAM
MORRIS
BEAR
BOGGS
FERGUSON
KNOX
DECATUR
JORDAN
WOODWARD
BURNSIDE
CHEST
BECCARIA
GULICH
CLEARFIELD
SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA
J.P. LESLEY, STATE GEOLOGIST
GEOLOGICAL MAP
OF
CLEARFIELD COUNTY
1884
Scale: 6 miles to 1 inch.

Appendix B: Historical Data

Table 1: Historical Permits

Permit	Issued	Company	Mine	Type
#263M38		Thompson Brothers Coal		Underground
#18468-M		Thompson Brothers Coal		Underground
#262M61		W.K. Turner and Sons	Turner Strip Mine	Surface
#262M49		Homer Maney	Maney Job	Surface
3266BSM15	1966	Thompson Brothers Coal	Thompson #106	Surface
3266BSM7	1966	Thompson Brothers Coal	Thompson #106	Surface
3266BSM10	1966	Thompson Brothers Coal	Morrisdale Strip	Surface
3266BSM10	1966	Thompson Brothers Coal Company	Emigh #1	Surface
3267BSM37	1967	Thompson Brothers Coal	Thompson #106	Surface
3268BSM31	1968	Thompson Brothers Coal	Thompson #001	Surface
17810104	1981	Thompson Brothers Coal	Morris #2	Surface
17813055	1981	Thompson Brothers Coal Company	Emigh #1	Surface
17820149	1982	Graham Brothers	Dunlap	Surface
17841606	1984	Avery Coal Company	Van Tipple	Tipple
17870129	1987	Sky Haven Coal Company	Emigh #2	Surface
Pre App		King Coal Company	Royal Job	Surface
17010115	2001	King Coal Company	Royal Job	Surface/Remining

Table 2: Correlation of Restoration Plan Points to Historical/Other Sampling Points

Restoration Plan	Other	Source
ER-1	STREAM TOP	ERLWA
ER-1	GB-8	17810129
ER-1	GB-4	17810129
ER-1	EMR-9	WPCAMR
ER-1	TB-234	3266BSM10
ER-2	SPOIL	ERLWA
ER-2	KC-58	17010115
ER-2	AT-17	17841606
ER-2	GB-5	17820149
SPRING	KC-57	17010115
ER-3	S8-17	ERLWA
ER-4	S8-16	ERLWA
ER-6	N8-12	ERLWA
ER-6	KC-52	17010115
ER-9	N8-10	ERLWA
ER-9	KC-81	17010115
ER-10	KC-53	17010115
ER-11	N8-8	ERLWA
ER-12	KC-83	17010115
ER-13	S8-14	ERLWA
ER-14	S8-13	ERLWA
ER-15	N8-6	ERLWA
ER-16	S8-12A	ERLWA
ER-17	N8-5	ERLWA
ER-18	N8-4	ERLWA
ER-19	S8-9	ERLWA
ER-22	S8-5	ERLWA
ER-23	S8-2	ERLWA
ER-25	EMR7	WPCAMR
ER-25	POWERLINE	ERLWA
ER-25	TB-236	3266BSM10

Restoration Plan	Other	Source
ER-27	S7-1	WPCAMR
ER-28	WB-42	ERLWA
ER-29	S7-3	ERLWA
ER-31	WB-81	ERLWA
ER-32	BG-66	ERLWA
ER-36	N6-3	ERLWA
ER-38	KC-81	17010115
ER-39	N6-1	ERLWA
ER-44	S5-6	ERLWA
ER-45	S5-4	ERLWA
ER-46	N5-3	ERLWA
ER-47	S5-3	ERLWA
ER-48	S5-2	ERLWA
ER-49	N5-2	ERLWA
ER-50	N5-1	ERLWA
ER-52	S5-1	ERLWA
ER-54	GB-1	17820149
ER-54	TB-242	3266BSM10
ER-55	STREAM BOTTOM	ERLWA
ER-55	TB-243	3266BSM10
ER-55	SH-3	17870129
ER-56	SH-26	17870129

Other Data Collected as Part of the Restoration Plan

Bottom Pond

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/28/02		3.8	1230	122		0	6.66		9.79	27.8	717

ER-3

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	4.75	3.8	295	30	1.7178	0	0.38	0.0217	2.2	4.17	92
7/23/03	2.5	3.6	255	28	0.8438	0	0.98	0.0295	0.98	2.52	64
9/18/03	3	4.2	167	65	2.3506	3	19.5	0.7052	0.49	2.18	44

ER-4

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	1.6	5.4	57	4	0.0771	6	0.08	0.0015	0.11	0.06	24

ER-7

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/17/03	3.7	3.3	2260	365	16.28	0	2.26	0.1008	37.4	49.9	1603
8/28/03	2	3.3	2280	295	7.1123	0	2.57	0.0619	34.8	52.5	1437
10/22/03	1.5	3.3	2730	317	5.732	0	2.83	0.0511	38.2	50.4	1482
1/22/04	10	3.5	2650	372	44.8438	0	3.59	0.4327	37.3	49.6	1373

ER-20

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
8/28/03	3	3.8	587	55	1.989	0	0.88	0.0318	3.89	13.9	258
12/18/03	10	4.2	533	51	6.1479	3	0.41	0.0494	4.32	11.4	203

ER-22

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	4.5	4.9	83	8	0.4339	4	0.28	0.0151	0.26	0.09	30
6/17/03	3.4	4.9	82	10	0.4098	6	0.03	0.0012	0.15	0.07	23
8/28/03	1.58	5.7	86	9	0.1714	8	0.16	0.003	0.19	0.14	24
5/26/04	6.25										

ER-23

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03		3.5	742	110		0	2.45		9.78	11.3	299
6/17/03	3.5	5.4	53	16	0.675	7	0.03	0.0012	0.07	0.02	17
10/22/03	1.6	5.4	94	14	0.27	8	0.09	0.0017	0.09	0.06	15
11/18/03		4.45	59	6		6	3.74		2.97	0.3	13
4/21/04	1.5	5.3	50	6	0.1084	5	1.72	0.0311	1.15	0.1	15
5/26/04	7.5	5.5	64	6	0.5424	8	0.2	0.018	0.18	0.05	13

ER-27

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	2.5	5.1	76	4	0.1205	6	0.09	0.0027	0.08	0.05	35
6/17/03	22.2	5.2	70	16	4.2818	7	0.03	0.008	0.07	0.04	23
7/23/03	6.2	5.2	94	0	0	10	0.12	0.0089	0.1	0.06	35
8/28/03	10.5	5.4	90	17	2.1517	0	0.15	0.0189	0.07	0.07	27
9/18/03	10	5.3	90	13	1.5671	7	0.1	0.012	0.08	0.05	21
1/22/04	10	5.3	98	20	2.4109	7	0.05	0.006	0.08	0.06	20

ER-37

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/12/03	0.4	6.3	954	56	0.27	30	7.35	0.0354	0.02	38.1	535
6/19/03	1	6.2	891	29	0.3495	55	25.8	0.311	0.18	39.1	414
7/23/03	0.1	6.4	852	38	0.0458	46	9.9	0.0119	0.06	34.4	563
8/28/03	2.2	6	187	7	0.1856	18	16	0.4243	0.05	3.18	53
9/18/03	2.2	5.8	265	15	0.3978	17	17.3	0.4588	0.05	3.38	78

ER-37B

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
8/28/03	0.1	6.3	891	26	0.0313	57	13.6	0.0163	0.13	38.1	411
9/18/03		6.1	1060	39		57	4.95		0.61	39.7	406

ER-42

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/26/04		3.4	684	76		0	2.82		6.6	10.3	280

ER-51

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/14/03		6.1	2020	120		60	97.6		0.49	11.6	1224
9/18/03		6	1940	78		86	134		0.71	8.98	879
10/22/03		6	2230	129		70	146		3.11	12.3	1175
11/18/03		3.6	258	60		0	7.36		5.48	6.6	190
12/18/03		3.8	820	81		0	25.7		6.9	9.23	289
3/18/04		4.5	1070	90		5	116		8.31	10.6	396
4/21/04	0	3.6	770	59	0	0	10.5	0	6.26	10.2	299

ER-52

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/14/03	2	3.8	750	38	0.9161	0	12.1	0.2917	0.13	4.38	324
6/19/03	1.6	3.7	645	32	0.6172	0	9.04	0.1743	0.14	3.97	314
9/18/03	2	3.4	1050	89	2.1457	0	260	6.2684	6.43	6.27	390
10/22/03		3.8	831	36		0	94		3.41	4.79	289
11/18/03	2.5	3.8	615	34	1.0246	0	103	3.1041	7.58	6.12	263
12/18/03		4	717	36		0	151		3.47	4.82	284
3/18/04	1	3.9	764	28	0.3375	0	212	2.5556	3.76	4.93	317
4/21/04	10	3.6	670	26	3.1342	0	11.9	1.4345	0.17	3.87	301

ER-54

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/14/03		3.6	597	74		0	1.56		4.51	6.74	242
7/23/03		3.4	785	72		0	4.32		4.82	10.1	338
9/18/03		3.5	880	100		0	2.28		6.41	10.7	299
10/22/03		3.6	804	82		0	4.39		5.59	9.32	268
11/18/03		3.5	557	42		0	4.49		4.2	6.33	220
3/18/04		3.8	683	63		0	2.12		5.19	8.16	265
4/21/04		3.7	680	49		0	1.37		4.26	7.66	265
9/16/04		3.7	638	44	0	0	1.63	0	4.12	8.48	261

ER-56

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/19/03		5.3	442	13		7	0.25		1.26	4.75	187
10/22/03		5.9	585	11		15	1.08		0.81	5.28	223
9/16/04		6.6	458	0	0	19	0.64	0	0.29	3.9	174

N4-1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/15/01	7.5	6.7	335	0	0	20	0.46	0.0415	0.13	1.01	95

N5-7

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/15/01	15	3.2	1330	122	22.0602	0	8.1	1.4646	6.65	14.1	589

N6-1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/15/01		4.3	566	24		4	0.5		2.56	4.99	221

N8-1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
10/30/01		3.3	1150	152		0	57.7		0.06	16.6	525

N8-11

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/12/01		3.2	2730	418		0	4.15		38.5	58.9	1861

N8-12

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/12/01		3.3	2090	380		0	45.4		20.7	40.2	1223

N8-3

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
10/30/01		3.4	1420	344		0	37.2		31.4	27	795

N8-4

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/12/01		3.3	1660	682		0	3.16		70.4	17.9	1104
10/30/01		3.4	1460	324		0	2.06		69.4	17.3	960

N8-5

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/12/01		3.3	891	270		0	2.43		31.5	7.69	407

N8-7

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/12/01		2.5	3820	1924		0	91		131	18.6	2894
10/30/01		2.6	5990	2060		0	91.7		144	19.7	2097
12/21/01		2.6	5300	1698		0	131		131	24.1	3074
1/18/02		2.8	5910	2172		0	106		169	25.2	3695
2/26/02		2.5	6360	2630		0	114		178	27	3555
5/24/02		2.6	5100	1440		0	54.2		123	24	2412
6/24/02		2.8	2720	962		0	21.7		90.7	28.6	1645

N8-8

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/12/01		2.9	2650	662		0	12.7		53.8	36.4	1557

POWER LINE

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
12/21/01		3.1	975	270		0	17.3		27.2	9.6	285
1/18/02		3.4	914	210		0	8.25		20.1	12.2	334
6/24/02	9.1	3.3	1260	232	25.45	0	5.12	0.5616	22.3	20.7	715
7/29/02	8.86	3	1780	294	31.4008	0	8.18	0.8736		34.1	1263
8/27/02	8.18	3	1890	302	29.7796	0	11.1	1.0945	25.7	37.6	1013

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/27/02	9.07	3	1250	246	26.8968	0	9.21	1.0069	17.8	23	602
10/31/02	8.89	3.2	1570	428	45.8675	0	24.4	2.6148	46.3	21.2	933
11/28/02	8.94	3.2	1240	310	33.4086	0	14.2	1.5303	32.6	16.5	634

S5-1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/15/01	1	5.6	1500	78	0.9402	18	34.3	0.4134	0.06	11	816

S5-2

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/15/01	1	3.6	457	40	0.4821	0	1.09	0.0131	3.43	1.97	158

S5-4

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/15/01	25	3.2	2310	170	51.2328	0	46.8	14.1041	0.26	22.5	1420

S5-5

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/15/01	25	3	5180	338	101.863	0	80.1	24.1397	1.31	36.9	2048

S5-6

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/15/01	35	3.1	1560	154	64.9753	0	12.7	5.3583	8.5	15.6	660

S6-2

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/15/01		3.1	1770	182		0	67.1		0.19	15.6	816

S6-3

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/15/01		5.7	1450	196		14	99.6		0.01	17	869

S7-1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
1/18/02		4.6	132	14		6	0.55		0.3	0.27	42

S8-1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/12/01		2	1800	446		0	18.5		38.7	24.8	967

S8-13

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/12/01		4	819	60		0	8.84		0.74	33.1	438

S8-14

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/12/01		3.2	1680	198		0	7.89		8.33	41.7	871
10/30/01		3.2	1670	100		0	4.18		9.54	43.2	777
7/29/02	28.68	3.3	1570	174	60.1572	0	3.68	1.2722		37	1247
8/27/02	28.6	3.2	1850	238	82.0545	0	5.43	1.872	4.25	42.5	1077
9/27/02	12.65	3.3	1800	240	36.5983	0	3.97	0.6053	40.2	17.6	1220
10/31/02	28.7	3.5	1730	244	84.4173	0	5.01	1.7333	15.9	39.8	1175
11/28/02		3.6	1550	200		0	4.49		14.3	36.7	993

S8-15

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/12/01		3.1	1760	180		0	3.95		10	41.3	897

S8-17

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/12/01		3.9	294	32		0	2.9		0.86	4.66	107

S8-4

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/12/01		3.3	1510	370		0	28.4		32.4	24.9	815
10/30/01		3.2	1450	360		0	23.7		35.5	23.7	788

SEEP S8-14

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/28/02		3.5	1650	226		0	8.62		16	40.3	1020

SPOIL

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
10/30/01		3.1	666	98		0	7.15		2.46	4.3	172
12/21/01		3.4	396	54		0	2.59		2.59	2.56	84
1/18/02		3.4	453	72		0	5.6		2.25	3.73	115
2/26/02		3.9	300	54		0	5.11		3.33	3.29	84
5/24/02		3.5	420	58		0	4.48		4.57	2.89	109

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/24/02		3.2	469	64		0	5.16		2.76	3.14	113
7/29/02		3.2	567	78		0	8.79			4.13	134
8/27/02		3.1	651	88		0	8.98		2.35	4.08	168
9/27/02		3.1	550	82		0	19		3.41	2.45	127
10/31/02		3.5	507	68		0	6.05		2.13	3.39	137
11/28/02		3.3	432	62		0	5.39		1.95	3.11	115

STREAM BOTTOM

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
10/30/01		3	1520	418		0	20.1		40.4	21.2	750
12/21/01											

STREAM TOP

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/12/01		3.1	718	92		0	7.61		1.98	4.39	206
10/30/01		3.9	205	46		0	2.45		4.79	4.18	85
12/21/01		4	227	44		0	0.15		4.34	2.74	64
1/18/02		4.4	217	44		4	0.08		4.66	2.69	85
2/26/02		3.3	418	62		0	0.24		5.39	2.59	107
5/24/02		4	255	42		0	0.07		5.25	2.3	81
6/24/02	6	3.8	266	46	3.3271	0	1.15	0.0831	4.89	2.69	86
7/29/02		4	250	24		0	8.91			4.8	77
10/31/02		4.1	283	46		0	0.81		5.73	3.98	94
11/28/02	10	4.3	265	42	5.063	4	0.24	0.0289	5.13	3.63	95

Top Pond

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/28/02		4.1	1400	158		2	1.36		14.2	31.4	811

Recent Historical Data Collected by Other Agencies

WPCAMR

BP

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01			350								

CR1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01		6.2	150	0		17.2	0.3		0.5	0.211	20

D2

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01		4.8	410	6.2		10.6	0.03		0.723	1.27	190

EMR1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01		6	700	5.2		14	0.707		1.96	6.23	301.2

EMR2

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01		3.7	940	74		0	1.4		7.43	11	383.3

EMR3

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01		3.4	1070	100		0	2.58		8.73	12.8	387.2

EMR4

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01		3.3	1150	104		0	3.16		7.83	12.9	415
11/15/01	30	3.2	1510	158	57.1397	0	15.1	5.4608	8.69	15	711

EMR5

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01		3.3	1250	140		0	108		8.32	15.2	527.5
11/15/01		3.1	1550	160		0	23.6		8.47	17	761

EMR6

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01		3.5	1100	142		0	11.4		10.4	16.1	428.3
11/15/01		3.2	1270	174		0	24.1		10.3	14.3	620

EMR7

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01		3.4		170		0	4.42		16.8	22.8	545.7

EMR8

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01		3.4	1300	184		0	4.57		18.2	22.8	524

EMR9

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01		4.1	280	52		4	0.3		6	3.36	87.6
12/21/01											

GHR1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01		4.3	600	48		6.4	0.3		5.81	5.08	253.1

HRB1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01		6.9	600	0		56	0.3		0.05	0.0096	319

MD1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01		7.4	810	0		84	0.3		0.5	0.05	324.3

PL1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01		5.2		3.6		8	0.3		0.5	0.089	20

SPHW

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/17/01			240								

Historical Data: Additional Historical Data for the Emigh Run Watershed

170 10 115 (King Coal)

KC1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/1/01		7.1	164	0		36	0.52			0.03	21

KC2

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/1/01		6.7	215	0		36	0.31			0.04	30

KC3

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/1/01		5.6	78	0		8	0.08			0.03	17
4/26/01		5.5	100	0		8	0.07			0.03	20

KC4

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/1/01	2	5.3	453	4	0.0964	8	0.03	0.0007		0.13	10
4/26/01	0	5.8	183	0	0	10	0.07	0		0.11	2
5/31/01	0	4.9	148	4	0	6	0.13	0	0.27	0.23	8
7/12/01	0	5	143	6	0	6	0.15	0	0.13	0.18	6
8/17/01		4.7	199	6		4	0.08		0.41	0.21	8
9/11/01		4.7	139	4		6	0.08		0.36	0.06	4
12/24/02		5.6	367	4		8	0.11			0.14	17
2/11/03		4.9	205	2		6	0.03			0.23	12
5/5/03		5.4	212	4		10	0.32			0.22	12
7/11/03		5.2	158	13		7	0.51			0.64	19
10/8/03		5.6	147	11		9	0.24			0.19	10
1/13/04		5.8	132	8	0	13	0.07	0		0.08	13
4/26/04		5.8	143	0	0	12	0.34	0		0.06	18
7/28/04		5.8	154	0	0	12	0.16	0		0.08	28

KC5

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/1/01		5.1	122	6		6	1.21		0.73	0.48	17
5/31/01		5.6	277	2		8	0.25		0.66	0.19	19
7/12/01		5.5	372	0		10	0.15			20	20
8/17/01		5.6	367	0		8	0.05			0.21	18
9/1/01		5.6	399	0		12	0.24			0.26	18

KC6

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	0	6.8	1060	0	0	34	0.66	0		0.14	76
4/26/01	0	6.9	895	0	0	34	0.76	0		0.16	146

KC7

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	2	4.6	651	32	0.7715	8	0.06	0.0014		2.49	146
4/26/01	1.5	4.8	528	12	0.2169	8	0.24	0.0043		1.2	127
5/31/01	1	4.5	649	26	0.3134	4	0.31	0.0037		1.35	152
7/12/01	1	4.4	712	36	0.4339	4	0.14	0.0016		3.31	186
8/17/01	1	4.4	567	28	0.3375	4	0.06	0.0007		2.34	131
9/11/01	1.5	4.4	613	26	0.4701	4	0.06	0.001		2.18	180
12/24/02	0.417	4.5	555	34	0.1709	6	0.78	0.0039		2.49	164
2/11/03	0.264	4.4	617	38	0.1209	4	0.02	0		2.84	180
5/5/03	0.1	4.6	530	24	0.0289	6	1.11	0.0013		1.79	124
7/11/03	0.1	4.6	525	31	0.0373	5	0.06	0		2.05	129
10/8/03	1	4.8	461	26	0.3134	6	0.05	0.0006		1.88	112
1/13/04	1	4.8	397	34	0	6	0.25	0		1.14	78
4/26/04	1	4.9	338	10	0	6	0.05	0		0.58	61
7/28/04	2	5.6	286	6	0	5	0.26	0		0.58	68

KC8

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	5	5	262	6	0.3616	6	0.03	0.0018		0.17	9
4/26/01	2.2	5.1	198	6	0.1591	6	0.12	0.0031		0.23	2
5/31/01	1	4.8	210	8	0.0964	4	0.15	0.0018	0.75	0.24	8
7/12/01	1.2	4.8	154	6	0.0867	6	0.12	0.0017		0.18	6
8/17/01		4.9	176	4		14	0.04		0.38	0.21	8
9/11/01		4.5	150	6		14	0.01		0.31	0.17	5
12/24/02		4.9	202	10		8	0.1			0.26	14
2/11/03		4.7	156	18		7	0.02			0.24	16
5/5/03		4.9	169	8		8	0.06			0.21	13
7/11/03		5	158	16		8	0.06			0.26	18
10/8/03		5.1	143	13		13	0.08			0.24	9
1/13/04		4.9	115	8	0	6	0.05	0		0.13	14
4/26/04		4.8	101	7	0	4	0.05	0		0.16	19
7/28/04		4.8	105	7	0	4	0.05	0		0.16	19

KC9

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	1	7	556	0	0	42	0.05	0.0006		0.03	12
4/26/01	0.9	7	221	0	0	40	0.13	0.0014		0.03	5

KC10

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	14	7.1	530	0	0	26	0.03	0.005	0.07	0.03	12
4/26/01	4.7	7.1	306	0	0	32	0.07	0.0039	0.07	0.03	10
5/31/01	1.6	7.1	334	0	0	62	0.18	0.0034	0.41	0.07	33
6/14/01	0.1	7	339	0	0	64	0.13	0.0001		0.01	36
7/12/01	0.1	7.4	326	0	0	68	0.64	0.0007	0.59	0.14	30
7/24/01											
3/21/02	50	6.9	606	0	0	30	0.06	0.0361	0.05	0.01	19
4/2/02	40	7.2	341	0	0	32	0.04	0.0192	0.04	0.01	12
4/17/02	14	6.5	409	0	0	44	0.04	0.0067	0.02	0.01	20
5/7/02	18	6.6	332	0	0	36	0.04	0.0086	0.03	0.01	20
5/30/02	5	6.7	292	0	0	46	0.13	0.0078	0.1	0.01	28
6/11/02	50	6.9	271	0	0	32	0.08	0.0482	0.1	0.01	19
6/27/02	140	6.7	304	0	0	20	36.3	61.2624	42.4	2.05	7
12/24/02	44	7	368	0	0	28	0.08	0.0424		0.01	21
2/11/03	3	6.8	443	0	0	34	0.17	0.0061		0.01	25
5/5/03	5	6.8	312	0	0	48	0.09	0.0054		0.02	34
7/11/03	5	6.7	290	0	0	69	0.04	0.0024		0.01	33
10/8/03	21	6.5	270	0	0	53	0.05	0.0126		0.02	18
1/13/04	21.5	6.6	239	0	0	33	2.07	0		0.05	13
4/26/04	77	7.3	259	0	0	34	0.85	0		0.06	24
7/28/04	225	6.8	162	0	0	29	0.73	0		0.04	24

KC11

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	3420	3.4	2040	260	10719.1232	0	36.07	1487.0722		36.56	1226
4/26/01		3.4	2100	290		0	14.74		25.63	35.41	1572

KC12

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	5	6.9	1520	0	0	42	1	0.0602	0.38	0.14	24
4/26/01		6.9	224	0		38	0.27		0.07	0.12	23
5/31/01	0.4	7.6	241	0	0	72	0.18	0.0008	0.48	0.07	32
7/12/01											
7/24/01											

KC13

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	0.5	5.5	85	0	0	8	0.29	0.0017		0.04	14
4/25/01	0.4	5.4	67	4	0.0192	6	0.46	0.0022		0.05	19

KC14

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	0.5	5.7	51	4	0.0241	6	0.47	0.0028		0.04	11
4/25/01	0.2	5.6	51	6	0.0144	6	0.06	0.0001		0.03	16

KC15

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	1	5.5	145	4	0.0482	6	1.57	0.0189		0.84	52
4/25/01	1	5.5	121	4	0.0482	8	0.85	0.0102		0.68	45

KC16

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	375	4.8	456	12	54.2465	6	0.22	0.9945		2.89	147
4/25/01	510	4.2	5.4	50	307.3972	2	0.35	2.1517	5.86	4.01	208
5/31/01	168	4.4	514	34	68.8569	4	0.28	0.567	4.57	4.22	219
6/14/01	75.7	4.3	553	40	36.5019	4	0.38	0.3467	5.02	4.98	247

KC17

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	1465	3.4	722	116	2048.5917	0	12.63	223.0492	10.41	9.25	317
4/25/01	1795	3.6	663	102	2207.1123	0	5.93	128.3154	10.16	9.93	298

KC18

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	1100	3.4	784	140	1856.4383	0	14.06	186.4394	12.76	10.2	366
4/25/01	1350	3.4	747	120	1952.8767	0	7.58	123.3567	11.49	12.31	348
5/31/01	366	3.3	1210	170	750.0493	0	16.8	74.1225	12.11	17.93	613
6/14/01	255.7	3.2	1430	210	647.3063	0	18.96	58.4425	13.43	21.43	395

KC19

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	0.5	4.5	253	10	0.0602	4	0.26	0.0015		0.46	102
4/25/01	0.2	4.4	228	10	0.0241	2	0.18	0.0004		0.3	73
6/1/01	1.2	4.6	201	0	0	4	2.09	0.0302	0.91	0.5	83
6/14/01											

KC20

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	0.5	4.2	408	20	0.1205	2	0.2	0.0012		4.26	187
4/25/01	0.1	4.1	280	14	0.0168	2	0.28	0.0003		2	109
6/1/01	0	4.1	335	18	0	2	0.43	0	1.43	3.04	140
6/14/01											

KC21

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01		4	758	50		0	1.28			9.54	407
4/25/01	1.1	3.8	698	46	0.6099	0	1.69	0.0224		7.4	354
6/1/01	3	3.9	754	50	1.8082	0	2.24	0.081	5.61	7.67	366
6/14/01	1.3	3.7	807	50	0.7835	0	1.65	0.0258		8.44	395

KC22

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	0	3.7	887	102	0	0	0.08	0		9.81	480
4/25/01	8.5	3.6	854	110	11.2712	0	0.1	0.0102		9.39	433
6/1/01	13.3	3.7	886	100	16.0328	0	0.28	0.0448	12.21	7.9	442
6/14/01	6	3.7	902	106	7.6668	0	0.16	0.0115		8.77	443

KC23

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	4	4.5	388	20	0.9643	4	0.21	0.0101	2.06	1.36	83
4/25/01	12.3	4.1	433	26	3.8551	2	0.32	0.0474	3.22	1	67
5/31/01	9.5	4.1	393	20	2.2904	2	0.35	0.04	2.4	1.09	76
6/14/01	5	4.1	420	24	1.4465	2	0.32	0.0192	2.16	1.3	72
7/12/01	2	4	439	24	0.5786	0	0.9	0.0216	2.61	1.97	80
7/24/01	0.4	3.9	454	26	0.1253	0	0.84	0.004	1.98	2.74	98

KC24

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/2/01	2	5.4	519	2	0.0482	8	0.06	0.0014		0.21	19
4/25/01	1.9	5.4	245	6	0.1374	6	0.23	0.0052		0.22	26

KC25

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	6	6.5	281	0	0	10	0.2	0.0144	0.07	0.08	22

KC26

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	2	6.4	72	0	0	10	0.03	0.0007	0.07	0.03	16

KC27

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	1.5	6.2	67	0	0	10	0.09	0.0016		0.03	15

KC28

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	0.5	5.7	74	0	0	8	0.26	0.0015		0.1	19

KC29

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	0.5	5.6	44	2	0.012	6	0.03	0.0001		0.03	13

KC30

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	0.5	5.4	40	2	0.012	6	0.03	0.0001		0.03	12

KC31

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	1	5.4	41	2	0.0241	6	0.04	0.0004		0.03	12

KC32

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	1	5.8	39	2	0.0241	6	0.05	0.0006		0.03	12

KC33

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	50.3	6.4	181	0	0	8	0.14	0.0848	0.07	0.06	19

KC34

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	1	3.5	547	62	0.7473	0	0.57	0.0068		2.06	141
4/25/01	5.2	3.6	645	74	4.6386	0	0.4	0.025		1.52	128

KC35

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	2	3.3	1080	180	4.3397	0	1.81	0.0436		10.41	608
4/25/01	15	3.4	882	120	21.6986	0	0.59	0.1066	14.44	6.73	388
5/31/01	4.3	33	1010	130	6.7386	0	1.24	0.0642	14.86	7.84	531
6/14/01	5	3.3	999	136	8.1972	0	1.06	0.0638		7.8	441
7/12/01	2.8	3.3	1060	140	4.7254	0	1.37	0.0462	15.86	8.89	542
7/24/01	2	3.3	1080	148	3.5682	0	1.43	0.0344	15.16	9.9	546

KC36

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	0.5	5.9	686	46	0.2772	18	63.57	0.3831		4.51	357
4/25/01	0.1	5.9	732	56	0.0675	16	56.89	0.0685		4.7	341
5/31/01	0.2	3.3	927	56	0.135	0	2.11	0.005	0.19	4.44	380
6/14/01	0.2	3.1	1010	66	0.1591	0	1.4	0.0033		4.6	357
7/11/01	0.2	3.2	960	80	0.1928	0	1.58	0.0038	0.32	4.56	379
7/24/01	0.2	3.2	959	50	0.1205	0	1.16	0.0027	0.2	5.06	388
3/21/02	0.203	3.2	819	44	0.1076	0	1.79	0.0043	0.08	4.53	288
4/2/02	0.15	3.3	860	44	0.0795	0	1.36	0.0024	0.09	4.68	315
4/17/02	0.144	3	935	70	0.1215	0	0.89	0.0015	0.1	4.95	300
5/7/02	0.084	3.3	916	44	0.0445	0	0.93	0.0009	0.1	4.81	319
5/30/02	0.137	3.1	1000	58	0.0957	0	1.79	0.0029	0.12	4.59	388
6/11/02	0.193	3.1	633	56	0.1302	0	1.29	0.003	0.15	4.04	356
6/27/02	1.19	3.5	341	28	0.4016	0	33.5	0.4805	2.81	1.28	90
12/24/02	0.176	3.6	742	30	0.0636	0	11.1	0.0235		4.65	350
5/5/03	0.2	3.4	791	46	0.1109	0	2.42	0.0058		4.23	316
7/11/03	0.23	3.3	816	53	0.1469	0	1.33	0.0036		4.32	382
10/8/03	0.14	3.3	904	52	0.0877	0	1.79	0.003		4.78	271
4/26/04	0.4	3.3	886	40	0	0	1.75	0		4.6	248
7/28/04	0.21	3.2	757	35	0	0	7.67	0		4.43	286

KC37

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	278	3.4	784	178	596.5194	0	9.86	33.0431	18.68	12	371
4/19/01	2250	3.5	645	126	3417.5342	0	5.79	157.0438	12.29	9.1	269
7/11/01	81.8	3.1	1630	270	266.2421	0	13.58	13.3909	23.17	32.75	859
7/24/01	14.2	3.1	1760	276	47.2451	0	20.56	3.5194	18.93	34.83	893
5/30/02		3.4	925	138		0	3.82		14.8	14.4	372
6/11/02		3.3	868	128		0	3.42		14.3	13.2	410
6/27/02		3.4	1000	174		0	6.51		16.3	17.3	628
12/24/02		3.4	694	158		0	8.42			7.64	284
1/2/03		3.6	376	70		0	5.62			3.98	124
1/29/03		3.4	974	136		0	6.4			16.8	455
2/11/03		3.4	928	136		0	6.42			15.9	418
2/25/03		3.6	724	132		0	5.34			11.7	321
3/7/03		3.5	828	120		0	4.59			11.2	339
3/24/03		3.9	514	70		0	1.79			7.44	218
4/15/03		3.8	723	100		0	2.76			12.9	333
5/5/03		3.5	1100	162		0	5.12			20.9	625
5/22/03		3.5	689	104		0	3.38			11.4	305
6/11/03		3.5	688	88		0	3.01			12	320
6/26/03		3.5	884	130		0	3.69			15.7	456
7/11/03		3.4	776	113		0	4.88			13.2	317
7/24/03		3.3	1050	166		0	6.89			17.1	561
8/26/03		3.3	1170	183		0	5.36			17.2	523
9/5/03		3.8	491	63		0	2.15			6.91	188
10/8/03		3.5	997	138		0	5.53			18.5	367

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
10/29/03		3.5	815	104	0	0	4.52	0		14.3	307
10/29/03		3.5	815	104		0	4.52			14.3	307
11/11/03		3.7	689	85		0	4.03			11.2	300
11/11/03		3.7	689	85	0	0	4.03	0		11.2	300
11/25/03		3.8	632	72		0	2.7			10.7	271
11/25/03		3.8	632	72	0	0	2.7	0		10.7	271
12/8/03		3.5	872	102		0	5.97			17.8	359
12/8/03		3.5	872	102	0	0	5.97	0		17.8	359
12/29/03		3.7	691	98		0	3.32			10.8	306
12/29/03		3.7	691	98	0	0	3.32	0		10.8	306
1/13/04		3.8	886	111	0	0	3.34	0		14.2	290
1/27/04		3.7	1110	159	0	0	6.12	0		19.5	436
2/11/04		3.6	989	151	0	0	6.23	0		16.9	371
2/24/04		3.6	891	115	0	0	5.83	0		14.6	319
3/9/04		4	560	54	0	0	1.86	0		8.67	232
3/30/04		3.5	735	84	0	0	4.21	0		16.5	343
4/8/04		3.5	792	76	0	0	3.35	0		12.5	338
4/26/04		3.7	520	58	0	0	1.76	0		6.51	192
5/12/04		3.5	884	120	0	0	3	0		13.2	415
5/25/04		3.6	693	83	0	0	3.3	0		10.9	288
6/16/04		3.3	998	130	0	0	4.48	0		14.3	392
6/24/04		3.3	1100	158	0	0	6.17	0		15.4	417
7/13/04		3.2	764	106	0	0	4.69	0		10.3	336
7/28/04		3.5	367	40	0	0	2	0		4.26	118
8/11/04		3.4	1050	115	0	0	5.08	0		17.5	430
8/31/04		3.4	792	95	0	0	5.5	0		12.3	303
9/14/04		3.6	771	87	0	0	3.84	0		12.6	311
9/28/04		3.7	608	72	0	0	2.69	0		8.88	229
8/6/06		3.4	687	95		0	5.12			10.5	236

KC38

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	1	4.7	247	6	0.0723	6	0.34	0.004		0.33	102
4/19/01	0.4	4.8	205	6	0.0289	6	0.06	0.0002		0.21	85
5/31/01	0.3	4.8	262	8	0.0289	4	0.18	0.0006		0.36	109
6/14/01	0.4	4.9	256	6	0.0289	6	0.17	0.0008		0.31	115
7/11/01	0.2	4.6	258	10	0.0241	4	0.55	0.0013		0.35	118
7/24/01	1	4.7	242	8	0.0964	10	2.39	0.0288		0.74	105
7/11/03	0.3	5	214	14	0.0506	6	0.96	0.0034		0.52	84
10/8/03	0.29	5.3	223	13	0.0454	7	0.35	0.0012		0.81	68
1/13/04	0.61	5.1	205	20	0	7	0.75	0		0.26	59
4/26/04	2.6	5.1	200	11	0	6	0.07	0		0.2	60
7/28/04	7	4.8	168	8	0	3	0.08	0		0.14	55

KC39

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	1.5	4.2	393	48	0.8679	2	0.1	0.0018		3.58	172
4/19/01	12	4.2	427	54	7.8115	4	0.03	0.0043		3.22	147
5/31/01	0.9	4.1	434	42	0.4556	2	0.2	0.0021		3.76	186
6/14/01											
7/11/01											
7/24/01											
3/21/02	2.64	4.1	430	57	1.814	1	0.01	0.0003	7.42	3.62	154
4/2/02	6.64	4.3	383	48	3.8421	4	0.02	0.0016	6	3.09	139
4/17/02	7.92	3.9	458	78	7.4469	0	0.01	0.0009	9.13	4.37	171
5/7/02	7.92	4.1	435	58	5.5374	2	0.01	0.0009	8.69	4.06	177
5/30/02	7.92	4.1	485	69	6.5877	1	0.02	0.0019	9.09	4.1	199

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/11/02	11.88	4	422	56	8.0198	0	0.03	0.0042	6.19	3.08	175
7/26/02	6.34	4.1	525	74	5.6556	2	0.03	0.0022	9.31	4.62	207
12/24/02	10.56	4.2	434	66	8.4017	2	0.02	0.0025		3.8	201
2/11/03	1.59	4.2	447	158	3.0284	2	0.3	0.0057		3.98	223
5/5/03	5.3	4.2	474	66	4.2167	4	0.29	0.0185		4.34	227
7/11/03	5.28	4.2	430	58	3.6916	3	0.01	0.0006		3.98	193
10/8/03	3.96	4.2	472	64	3.0551	3	0.32	0.0152		4.24	172
1/13/04	12	4.3	429	68	0	4	0.24	0		3.32	153
4/26/04	15.8	4.2	378	43	0	2	0.05	0		3.03	143
7/28/04	15	3.9	343	42	0	0	0.05	0		2.73	122

KC40

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	225	3.3	868	212	575.0136	0	9.01	24.438	22.3	13.42	427
4/19/01	1590	3.4	756	154	2951.7369	0	5.84	111.936	12.12	9.49	334
5/31/01	105	3.3	1320	194	245.5561	0	6.76	8.5564	20.48	24.54	721
6/14/01	87	3.2	1590	260	272.6794	0	6.74	7.0686	22.37	29.52	786
7/11/01	59.5	3	1800	360	258.2136	0	12.99	9.3172	32.26	35.35	1010
7/24/01	15.2	3	1940	312	57.1686	0	9.42	1.726	23.27	40.78	1009
5/7/02	10325.9	3.4	761	126	15684.0519	0	4.35	541.4732	14.8	11.6	288
5/30/02	825.8	3.4	1060	184	1831.6922	0	3.66	36.4347	19.3	18	562
6/11/02	1990.63	3.3	1010	190	4559.3607	0	3.6	86.3878	17.3	15.9	588
6/27/02	630.98	3.3	1270	240	1825.5202	0	5.41	41.1502	23.5	24.2	788
12/24/02	599.41	3.3	783	188	1358.4437	0	10.2	73.7027		9.13	312
2/11/03	520.91	3.4	1030	148	929.3605	0	4.86	30.5181		19.4	612
5/5/03	293.6	3.5	1200	192	679.5432	0	3.71	13.1307		23.2	649
7/11/03	293.64	3.4	805	137	484.9484	0	4.11	14.5484		15.7	500
10/8/03	567.4	3.5	1160	163	1114.9021	0	5.01	34.2678		21.7	455
1/13/04	1073	3.7	1010	131	0	0	3.19	0		17.7	358
4/26/04	1920.7	3.7	611	64	0	0	1.77	0		8.7	233
7/28/04	1925	3.5	442	53	0	0	1.92	0		5.53	153

KC41

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	4	4.4	247	14	0.675	4	0.05	0.0024	1.05	0.59	97
4/19/01	9.5	4.5	220	14	1.6032	4	0.11	0.0125	1.04	0.91	93
5/31/01	2.3	4.3	275	16	0.4436	4	0.14	0.0038	1.73	1.12	110
6/14/01	0.6	4.3	276	18	0.1301	2	1.53	0.011	2.18	1.46	118
7/11/01											
7/24/01											
3/21/02	4	4.2	250	20	0.9643	2	0.03	0.0014	1.13	0.78	83
4/2/02	66	4.5	220	14	11.1386	4	0.03	0.0238	1.01	0.82	74
4/17/02	7.92	4.1	242	14	1.3366	2	0.03	0.0028	1.05	0.97	81
5/7/02	9.9	4.4	249	10	1.1934	4	0.02	0.0023	1.08	1	83
5/30/02	15.84	4.5	246	10	1.9094	4	0.05	0.0095	1.1	1.04	82
6/11/02	19.8	4.3	215	10	2.3868	2	0.05	0.0119	1.02	1.11	78
6/27/02	7.92	4.4	303	16	1.5275	4	0.06	0.0057	1.3	1.82	95
12/24/02	5.3	4.5	254	14	0.8944	6	0.04	0.0025		0.95	97
2/11/03	0.66	4.5	289	12	0.0954	6	0.07	0.0005		1	128
5/5/03	2.6	4.4	282	18	0.5641	4	0.03	0.0009		1.36	120
7/11/03	2.64	4.4	258	24	0.7637	47	0.3	0.0095		1.59	102
10/8/03	3.96	4.4	328	25	1.1934	4	0.09	0.0042		1.75	100
1/13/04	13.5	4.6	259	34	0	6	0.3	0		1.1	75
4/26/04	15.8	4.7	115	9	0	4	0.05	0		0.93	32
7/28/04	20	4	270	23	0	0	0.22	0		1.93	92

KC42

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/8/01	1	4.6	194	10	0.1205	4	0.03	0.0003		0.39	76
4/19/01	9.6	4.6	166	10	1.1572	4	0.03	0.0034		0.36	66

KC43

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/12/01	1	4.5	169	10	0.1205	4	0.03	0.0003		0.9	52
4/19/01	0.5	4.7	141	8	0.0482	6	0.06	0.0003		0.66	48

KC44

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/12/01	1	3.8	406	101	1.2175	0	0.4	0.0048		3.81	155
4/19/01	0.1	3.7	744	270	0.3254	0	0.32	0.0003		7.78	413
5/31/01	2	3.4	1710	720	17.3589	0	3.41	0.0822		25.3	1250
6/14/01	2.3	3.3	1760	750	20.7945	0	4.95	0.1372		27.71	1257
7/11/01	1.1	3.2	1770	680	9.0169	0	5.16	0.0684		29.61	1237
7/24/01	0.6	3.3	1780	648	4.6869	0	8.66	0.0626	100.95	32.94	1187
5/30/02	1.98	3.3	1390	544	12.9844	0	2.05	0.0489	71.3	15.1	836
6/11/02	3.168	3.4	959	348	13.2899	0	1.46	0.0557	41.8	9.64	471
6/27/02	1.98	3.4	1400	570	13.605	0	3.56	0.0849	68	16.8	987
12/24/02	2.64	3.7	876	310	9.8656	0	0.54	0.0171		10	456
2/11/03	3.2	3.5	1370	550	21.2164	0	1.04	0.0401		16.6	1041
5/5/03	3.17	3.4	1290	499	19.0686	0	2.82	0.1077		17.8	1176
7/11/03	1.98	3.5	1500	462	11.0272	0	3.67	0.0875		20.1	722
4/26/04	3.2	3.6	981	228	0	0	0.6	0		14	401
7/28/04	6	3.3	676	140	0	0	1.14	0		8.21	303

KC45

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/12/01	3	3.7	444	78	2.8208	0	3.61	0.1305	10.74	237	173
4/19/01	4.4	3.6	514	92	4.8797	0	1.53	0.0811	9.76	1.94	190
5/31/01											
6/14/01											
7/11/01											
7/24/01											
3/21/02	1.98	3.3	769	280	6.6831	0	1.18	0.0281	37.5	7.53	261
4/2/02	5.98	3.6	500	110	7.9296	0	4.08	0.2941	15.3	2.88	169
4/17/02	1.13	3	916	334	4.5497	0	2.02	0.0275	47.1	9.5	308
5/7/02	2.64	3.6	485	88	2.8005	0	1.48	0.0471	12.8	2.56	154
5/30/02	0.754	3.2	1080	440	3.9992	0	2.7	0.0245	58.4	9.25	570
6/11/02	5.3	3.5	483	84	5.3667	0	0.79	0.0504	9.4	2.02	160
6/27/02	0.72	3.3	1150	470	4.0793	0	2.3	0.0199	55.8	11.1	677
12/24/02	7.92	3.8	430	80	7.6379	0	0.8	0.0763		2.46	157
2/11/03	0.38	3	1770	924	4.2326	0	5.35	0.0245		19.4	1331
5/5/03	1.1	3.2	1120	456	6.0466	0	8	0.106		12.6	632
7/11/03	1.13	3.4	767	291	3.9639	0	2.2	0.0299		9.2	324
10/8/03	0.5	3.1	1680	612	3.6887	0	11	0.0663		21.8	774
1/13/04	1	3.4	956	287	0	0	0.92	0		10.1	332
4/26/04	2.6	3.8	367	77	0	0	0.35	0		2.85	116
7/28/04	8	3.6	273	44	0	0	1.3	0		1.94	77

KC46

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/12/01	1	4	409	60	0.7232	0	0.03	0.0003		1.94	168
4/19/01	0.2	4	364	42	0.1012	0	0.45	0.001		1	134

KC47

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/12/01	5	2.9	1550	500	30.1369	0	8.63	0.5201		10.36	744
4/19/01	0.8	2.8	1810	630	6.0756	0	19.08	0.184		8.6	766

KC48

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/12/01	5	2.7	2620	1280	77.1506	0	87.69	5.2854	135.42	23.34	1512
4/19/01	6.9	2.7	2550	1260	104.8043	0	76.23	6.3406	132.09	15.26	1416

KC49

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/12/01	2	2.4	8100	3500	84.3835	0	484.4	11.6786		44.32	4144
4/19/01	6.7	2.4	9140	3550	286.7232	0	498.2	40.2381		37.09	3872

KC-52

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/12/01	1.5	3.4	2050	328	5.9309	0	21.81	0.3943		57.05	1196
4/25/01	1.5	3.5	1890	300	5.4246	0	9.89	0.1788		59.73	1350
12/24/02	0	3.4	2050	352	0	0	25.8	0		41.8	1313
2/11/03	0.4	3.3	2130	310	1.4947	0	19.7	0.0949		44.7	1414
5/5/03	4	3.3	2140	320	15.4301	0	14.8	0.7136		47	1303
7/11/03	4	3.2	2050	322	15.5265	0	23.2	1.1186		42.8	1626
10/8/03	7.9	3.3	2190	328	31.2363	0	28.7	2.7331		45.7	1179
1/13/04	15	3.4	2430	317	0	0	29	0		42.8	1114
4/26/04	12	3.2	3120	276	0	0	29.7	0		43.8	1005
7/28/04		3	2090	286	0	0	17.7	0		44.4	1052

KC-53

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/1/02	1.58	2.4	5250	1668	31.7696	0	80.1	1.5256	127	25.1	2240
4/2/02	1.3	2.4	6390	2086	32.6901	0	105	1.6454	152	25.3	2870
4/17/02	0.344	2.2	6560	2348	9.7368	0	114	0.4727	160	28.1	4008
5/7/02	0.22	2.7	4740	1752	4.6464	0	66.6	0.1766	139	25	2868
5/30/02	0.264	2.5	4280	1488	4.7355	0	55.4	0.1763	124	26	2264
6/11/02	0.44	2.6	4880	1530	8.1152	0	51.4	0.2726	108	23.4	1979
6/27/02	0.466	2.5	4600	1320	7.4151	0	44.5	0.2499	99.8	28.5	2064
12/24/02	0.088	2.6	5070	1932	2.0495	0	58.4	0.0619		25.4	2944
5/5/03	1.6	2.6	6350	2000	38.5753	0	82	1.5815		35.1	2517
7/11/03	1.6	2.5	3970	935	18.0339	0	24.6	0.4744		30.5	2391
10/8/03	1	2.8	2980	854	10.2947	0	36.7	0.4424		37.1	1423
1/13/04	2.6	3.1	2710	563	0	0	15.8	0		35.5	1405

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
4/26/04	5.3	2.8	2810	645	0	0	14.8	0		29.2	1098
7/28/04	10	2.8	2120	386	0	0	8.59	0		25.7	1018

KC-54

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/21/02	1.13	2.6	2090	990	13.4856	0	24.8	0.3378	98.4	13.9	1168
4/2/02	0.88	2.7	2000	958	10.1626	0	28.5	0.3023	99.2	13.5	1171
5/7/02	3.17	2.7	2770	1258	48.0728	0	50.5	1.9297	109	13.9	1598
5/30/02	2.64	2.6	2930	1342	42.7086	0	53.3	1.6962	114	15	1436
6/11/02	2.64	2.6	2360	958	30.488	0	35.6	1.1329	85.5	11.7	1190
6/27/02	0.226	2.7	2450	1080	2.9423	0	51.2	0.1394	91.6	22.7	1368
12/24/02	2.6	2.7	2240	1194	37.4229	0	38.9	1.2192		14.9	1442
5/5/03	0.2	2.8	2190	800	1.9287	0	41.3	0.0995		19.4	1242
7/11/03	0.22	2.6	2060	795	2.1083	0	31.6	0.0838		16.1	1156
10/8/03	2.6	2.7	2750	1082	33.9125	0	40.3	1.2631		24.1	1225
1/13/04	1.8	2.9	1840	562	0	0	26.6	0		14.5	654
4/26/04	7.9	2.8	1810	511	0	0	18.4	0		14.8	562
7/28/04	9	3.6	1910	42	0	0	26	0		17.5	678

KC-56

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
4/17/02	17	3.5	203	40	8.1972	0	0.12	0.0245	4.11	2.3	67
5/7/02	18	4.1	234	40	8.6794	2	0.1	0.0216	5.53	2.98	87
5/30/02	14	4	239	40	6.7506	0	0.37	0.0624	5.16	2.68	83
6/11/02	25	3.9	230	40	12.0547	0	0.2	0.0602	4.9	2.42	90
6/27/02	7	4	226	44	3.7128	0	1.23	0.1037	4.23	2.91	82
12/24/02	15	4.3	220	42	7.5945	4	0.09	0.0162		3.16	86
2/11/03	8	4.1	217	38	3.6646	2	0.05	0.0048		2.59	79
5/5/03	9	4.2	226	42	4.5567	2	0.2	0.0216		2.65	82
7/11/03	9	4.1	206	41	4.4482	1	0.34	0.0368		2.87	78
10/8/03	3	4.2	239	47	1.6997	2	1.16	0.0419		3.98	76
1/13/04	34.5	4.2	225	60	0	3	0.06	0		2.45	78
4/26/04	80	4	220	35	0	0	0.06	0		2.13	61
7/28/04	80	3.7	214	40	0	0	0.36	0		2.78	64

KC-57

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/12/01	4	4.3	219	18	0.8679	4	0.03	0.0014	1.49	1	69
4/10/01	9	4.5	190	18	1.9528	4	0.12	0.013	1.89	1.5	71
4/2/02	38.35	4.5	182	30	13.869	4	0.07	0.0323	1.95	1.1	59
4/17/02	48.3	3.8	160	22	12.8094	0	0.05	0.0291	1.85	1.19	52
5/7/02	32.7	4.2	184	22	8.6722	2	0.02	0.0078	2.47	1.47	67
5/30/02	23.1	4.1	210	24	6.6831	2	0.04	0.0111	2.69	1.85	72
6/11/02	95.68	4	194	18	20.7612	0	0.04	0.0461	2.09	2.91	71
6/27/02	20.46	4.1	232	34	8.3857	2	0.28	0.069	3.47	3.46	88
10/31/02	4	4.2	185	20	0.9643	4	0.42	0.0202		1.65	62
11/15/02	0.1	4.3	164	26	0.0313	2	0.05	0		1.59	59
12/3/02	0.1	4.4	232	26	0.0313	4	0.15	0.0001		1.68	75
12/24/02	13	4.4	221	32	5.0147	4	0.17	0.0266		1.95	76
1/2/03	78	4.4	193	14	13.1638	4	0.06	0.0564		1.17	64
1/29/03	0.1	4.2	286	36	0.0433	2	0.1	0.0001		2.04	96
2/11/03	1	4.2	223	30	0.3616	2	0.05	0.0006		1.64	85
2/25/03	17	4.5	173	22	4.5084	4	0.02	0.004		1.07	68

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/7/03	22	4.4	208	22	5.8345	4	0.06	0.0159		1.17	79
6/11/03	5	4.3	240	28	1.6876	6	0.04	0.0024		2.23	86
6/11/03	5	4.2	240	28	1.6876	6	0.04	0.0024		2.23	86
7/11/03	1	4.1	203	31	0.3736	2	0.03	0.0003		2.5	77
10/8/03	1	4.2	215	32	0.3857	3	0.05	0.0006		3.5	66
1/13/04	19.3	4.4	243	46	0	4	0.1	0		2.45	75
4/26/04	49	4.1	217	26	0	1	0.09	0		2.24	60
7/28/04	75	3.8	174	24	0	0	0.26	0		2.49	52

KC-58

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/12/01	52	3.7	318	34	21.3128	0	0.9	0.5641	2.44	2.63	87
4/12/01	92.2	3.7	337	46	51.1267	0	1.01	1.1225	3.72	3.14	110
4/2/02	128.07	3.9	234	36	55.5788	0	1.71	2.6399	2.63	2.24	61
4/17/02	167.4	3.2	261	34	68.611	0	0.68	1.3722	2.9	2.85	79
5/7/02	1200.86	3.8	261	32	463.2358	0	0.64	9.2647	2.81	2.61	83
5/30/02	124.4	3.5	339	42	62.9838	0	1.15	1.7245	3.66	3.2	104
6/11/02	281.17	3.6	254	30	101.6833	0	0.75	2.542	2.4	2.32	86
6/27/02	66.66	3.6	311	48	38.5714	0	1.5	1.2053	3.35	3.9	114
12/24/02	43.2	3.7	325	46	23.9552	0	1.63	0.8488		3.35	104
2/11/03	25.4	3.5	335	40	12.2476	0	2.43	0.744		3.56	107
5/5/03	91.4	3.6	367	46	50.6831	0	1.1	1.2119		3.81	108
7/11/03	91.4	3.6	290	41	45.1741	0	1.22	1.3442		3.06	78
10/8/03	51.2	3.7	311	42	25.9226	0	2.09	1.2899		3.47	85
1/13/04	195.1	4	288	50	0	0	1.18	0		2.77	80
4/26/04	1644.4	3.8	226	27	0	0	0.59	0		1.96	55
7/28/04	515	3.7	174	25	0	0	0.78	0		1.71	49

KC-61

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/30/02		2.7	1810	990		0	209		66.8	4.46	1003
6/11/02		3	726	188		0	4.59		2.61	0.47	146
6/27/02		2.8	1320	600		0	176		53.9	4.23	657

KC-80

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
4/19/01		3.3	1970	280		0	25.68		18.54	56.41	1276
6/1/01		3.2	2680	370		0	27.52			78.83	1746
7/11/01		3.3	2610	440		0	96.03			72.12	1860
7/24/01		3.6	2520	438		0	115.13		17.78	69.6	1637
8/14/01		3.5	2490	430		0	78.2		15.4	52.5	1624
9/11/01		3.4	2180	350		0	113			42.5	1408
10/15/01		2.9	2740	372		0	43.3		14.3	56.8	1579
12/24/02		3.1	2470	360		0	37			59.7	1661
2/11/03		3	2180	258		0	13.4			52.3	1359
5/5/03		3.6	2500	400		0	69.2			57	1583
7/11/03		3.2	2200	339		0	65.9			55	1484
10/8/03		3.2	2440	336		0	66.3			54.4	1258
1/13/04		3.6	2420	322	0	0	52.1	0		49.8	1266
4/26/04		3.2	2300	310	0	0	54.1	0		48.5	1255
7/28/04		2.9	2230	332	0	0	75.5	0		60.3	1188

KC-81

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/7/02	0.256	2.9	2390	846	2.6107	0	8.88	0.0274	92.1	25.2	1417
5/30/02	3.96	2.5	3510	1282	61.1988	0	59.87	2.858	105	14.6	1496
6/11/02	6.841	2.9	2300	690	56.9021	0	10.3	0.8494	67.4	27.1	1431
6/27/02	7.92	3.1	2290	650	62.058	0	3.66	0.3494	67.6	35.9	1543
5/5/03	2.6	3.2	2400	624	19.5576	0	2.22	0.0695		39.5	1561
7/11/03	2.6	2.9	2590	711	22.2844	0	10.4	0.3259		37.3	1635
10/8/03	15.8	3.1	2320	484	92.1854	0	4.75	0.9047		42.6	1285
1/13/04	15.8	3.3	2280	368	0	0	1.81	0		36	1131
4/26/04	15.8	3.2	2210	370	0	0	2.35	0		31.6	1130
7/28/04	20	3	1910	290	0	0	3.34	0		24.5	979

KC-83

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
4/2/02	4.5	2.6	2640	1324	71.8224	0	61.8	3.3524	115	14.2	1594
4/17/02	3.96	2.3	4890	1602	76.4746	0	71.9	3.4322	126	16.9	2463
5/7/02	5.94	2.6	4130	1322	94.6624	0	70.1	5.0195	119	14.9	1910
5/30/02	0.417	3	2190	636	3.197	0	3.17	0.0159	72.9	27.6	1227
6/11/02	7.92	2.6	2840	1280	122.2066	0	65.3	6.2344	95.1	11.7	1526
6/27/02	1.86	2.6	4550	1650	36.9961	0	79.4	1.7803	116	14.9	2092
12/24/02	10.56	2.5	4920	1768	225.0639	0	105	13.3663		16.6	2373
5/5/03	0.5	2.6	2970	1350	8.1369	0	57.9	0.3489		18.9	1773
7/11/03	0.5	2.6	1830	734	4.4241	0	38.2	0.2302		13.7	981
1/13/04	1.6	3	1810	573	0	0	40.4	0		14.2	692
4/26/04	5.3	2.9	1450	380	0	0	9.3	0		10.5	397

KC-89

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
4/2/02	80	4.4	354	10	9.6438	6	1.02	0.9836	1.01	1.13	73
4/17/02	14	4	341	16	2.7002	0	0.81	0.1367	0.59	1.63	72
5/7/02	58	4.4	328	10	6.9917	4	1	0.6991	1	1.26	70
5/30/02	20	4.1	351	12	2.8931	2	0.33	0.0795	0.52	1.35	83
6/11/02	135	4	335	14	22.7835	0	0.15	0.2441	1.14	1.27	97
6/27/02	36	4.4	346	14	6.0756	4	0.77	0.3341	0.5	1.3	85
12/24/02	8	5.4	259	8	0.7715	8	0.09	0.0086		1.35	103
5/5/03	1	4.6	331	12	0.1446	6	1.99	0.0239		1.65	83
7/11/03	1	6	233	13	0.1567	8	11.3	0.1362		1.06	61
10/8/03	17	4.7	317	19	3.8936	5	0.21	0.043		1.6	78
1/13/04	121.4	4.6	304	29	0	5	0.76	0		1.09	67
4/26/04	138	4.5	297	16	0	4	0.74	0		0.9	65
7/28/04	295	4.2	295	14	0	1	0.16	0		1	71

KC-90

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
4/2/02	5454	3.4	955	200	13149.3698	0	9.77	642.3467	20.5	14.2	320
4/17/02	535.88	3	1000	196	1266.1449	0	7	45.2194	18.2	17.2	594
5/7/02	5050.66	3.3	1040	186	11324.5483	0	7.78	473.6827	20.6	16.5	530
5/30/02		3.3	1320	234		0	5.56		23.7	23.2	676
6/11/02	1377.95	3.3	1290	250	4152.726	0	6.67	110.7947	23.7	21.9	875
6/27/02	439.05	3.3	1530	300	1587.7972	0	7.59	40.1712	26.9	29.4	913

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
12/24/02	284.89	3.2	1090	308	1057.7614	0	18.5	63.5343		14.1	846
2/11/03	248.69	3.3	1240	194	581.5939	0	8.05	24.1331		24.7	705
5/5/03	287.8	3.4	1480	270	936.7298	0	6.76	23.4529		28	829
7/11/03	287.8	3	1100	190	659.1802	0	6.41	22.2386		21.8	546
10/8/03	334	3.4	1290	162	652.2608	0	6.96	28.023		26.2	454
1/13/04	745.9	3.6	1220	160	0	0	4.72	0		23.1	469
4/26/04	996.4	3.5	800	94	0	0	3.52	0		13.5	287
7/28/04	1425	3.2	657	97	0	0	3.5	0		9.26	273

KC-91

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
4/2/02	204.09	3.8	353	48	118.0926	0	1.16	2.8539	3.17	4.77	98
4/17/02	186.1	3.2	458	52	116.6566	0	1.39	3.1183	3.69	6.94	153
5/7/02	393.66	3.6	528	54	256.2564	0	1.46	6.9284	4.91	8.8	204
5/30/02	109.1	3.4	1030	140	184.1249	2	2.5	3.2879	12.3	18.6	563
6/11/02	359.06	3.4	1010	128	554.0344	0	2.03	8.7866	12.8	19.1	573
6/27/02	143.43	3.3	1170	204	352.7199	0	3.77	6.5184	15.2	26.7	747
12/24/02	150.7	3.8	384	40	72.6663	0	1.61	2.9248		5.2	123
2/11/03	130.5	3.3	1010	120	188.778	0	4.05	6.3712		18.3	538
5/5/03	126.9	3.4	1360	188	287.5936	0	4.34	6.6391		25.3	695
7/11/03	126.9	3.4	821	93	142.267	0	3.14	4.8034		15.1	420
10/8/03	189.2	3.4	1420	214	488.0841	0	6.94	15.8285		27.2	589
1/13/04	399.8	3.6	1020	123	0	0	4.95	0		16.6	341
4/26/04	543.7	3.6	551	50	0	0	2	0		8.38	194
7/28/04	622	3.5	362	38	0	0	1.73	0		4.6	111

1781010 4 (Thompson Bros)

TB-1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4

TB-1A

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/15/85		4.9	1900	338		5	114			13.9	1809
1/16/86	12	3.79	2490	364	52.6553	0	123	17.7928		15	2049
5/30/86		2.78	3300	493		0	125			13.9	2100
8/8/86		4.21	3300	360		0	89			18.6	2318
6/1/88		2.77	3670	490		1	171			19.1	2206
8/4/88		6.31	500	5		70	0.62			1.73	162
10/31/88		7.55	500	2		87	0.3			0.49	158
2/14/89		6.53	500	6		26	0.07			0.06	166
4/27/89		7	720	1		39	0.02			0.15	313
8/3/89		7.11	700	4		73	0.1			0.04	238
11/29/89		7.76	550	1		96	0.27			0.04	190
2/9/90		6.11	600	8		14	0.2			0.07	234
6/5/90		6.41	500	5		21	0.26			0.06	216
8/7/90		7.17	600	3		25	0.02			0.04	231
11/29/90		6.95	700	6		27	0.02			0.04	223
1/23/91		6.91	600	4		11	0.04			0.09	247
12/5/91		9.45	400	1		51	0.38			0.09	119
3/18/92		8.18	420	2		30	0.07			0.05	178
9/29/92		6.91	480	2		56	0.02			0.28	180

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
12/28/92		6.19	650	4		22	0.09			0.3	208
10/3/94		6.66	520	3		83	0.16			0.18	193
12/27/94		6.64	580	2		49	0.21			0.04	214
6/28/95		6.61	780	5		53	0.03			0.04	208

TB-2

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/14/88		4.8	320	70		4	0.35			4.01	159
6/1/88		4.89	380	21		3	0.69			3.9	149
8/4/88		5.87	410	6		17	0.65			2.92	147
10/31/88		6.19	390	11		10	0.89			3.34	130
2/14/89		5.08	500	34		5	0.23			3.02	148
4/27/89		5.04	385	18		4	0.18			2.72	140
8/3/89		5.88	350	50		29	2.07			2.75	104
11/29/89		4.87	310	16		3	0.29			2.08	113
2/9/90		4.8	330	64		4	0.08			2.05	116
6/5/90		5.32	260	13		5	0.38			1.91	98
11/29/90		5.33	325	9		2	0.07			1.23	98
1/23/91		6.05	220	9		7	0.52			0.46	52
4/25/91		5.39	300	10		2	0.24			1.17	92
8/19/91		5.22	240	65		6	0.37			1.78	86
12/5/91		5.65	180	29		5	0.42			0.42	43
3/18/92		4.9	280	37		2	0.11			1.57	97
6/29/92		5.78	295	4		7	0.68			1.88	101
9/29/92		5.49	230	47		8	0.45			1.6	88
12/28/92		5.2	250	24		5	0.18			0.69	74
10/27/94		5.1	275	29		8	0.33			0.89	80

TB-3

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/14/88	1	5.47	74	18	0.2169	4	0.28	0.0033		0.04	21
6/1/88	1	5.86	44	8	0.0964	10	4.86	0.0585		0.05	17
2/14/89	1	5.32	90	12	0.1446	4	0.1	0.0012		0.12	17
4/27/89	1	5.42	85	14	0.1687	5	0.34	0.004		0.04	30
11/29/89	1	5.45	80	4	0.0482	4	0.06	0.0007		0.14	28
2/9/90	1	5.26	80	22	0.2652	4	0.14	0.0016		0.1	20
8/7/90		5.96	95	4		3	0.07			0.08	17
1/23/91	1	5.75	80	4	0.0482	3	0.05	0.0006		0.07	25
4/25/91	1	5.68	80	6	0.0723	3	0.04	0.0004		0.04	27
9/26/96		5.85	60	3		7	0.06			0.04	19
11/21/96		5.3	45	5		7	0.15			0.04	14
1/8/97		5.34	65	7		7	0.06			0.04	16
4/21/97		5.29	80	6		8	0.07			0.05	13

TB-10

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/14/88		3.3	360	72		0	15.4			3.37	141
6/1/88		3.26	550	62		0	8.22			2.91	129
8/4/88		3.22	500	65		0	14.7			3.28	137
10/31/88		2.77	1282	237		0	76.4			11.9	396
2/14/89		3.73	900	130		0	30.9			7.1	341
4/27/89		3.6	1000	226		0	92			10.9	495
8/3/89		3.09	800	272		0	28.2			5.62	300
11/29/89		3.12	650	84		0	21.3			5.29	233

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/9/90		3.69	420	36		0	0.99			1.53	118
6/5/90		2.84	660	182		0	35.2			5.38	268
8/7/90		3.03	1040	117		0	44.5			7.09	314
11/29/90		2.9	1100	241		0	73.4			10.3	441
1/23/91		3.36	480	44		0	4.47			2.38	136
4/25/91		3	580	117		0	32.2			4.02	198
8/19/91		2.94	650	158		0	30.4			7.18	318
12/5/91		3.05	750	142		0	6.6			3.4	172
3/18/92		3.08	600	176		0	23.8			4.82	201
6/29/92		2.77	1100	358		0	87.7			12.4	570
9/29/92		3.1	775	131		0	16.4			5.45	242
12/28/92		3	750	157		0	12.5			6.01	350
9/26/96		5.56	270	20		16	7.08			4.42	22

TB-11

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/7/82	1	3.79	1400	150	1.8082	0	2.26	0.0272		17.1	756
12/9/82	1	3.17	1400	155	1.8684	0	7	0.0843		21.8	982
2/24/83	9	3.16	1500	194	21.0476	0	14	1.5189		21.9	925
5/26/83	200	3.06	2400	634	1528.5479	0	5.46	13.1638		55.2	2040
8/19/83	40	3.34	1900	328	158.1589	0	1.46	0.704		30.8	1335
12/6/83	50	3.25	1180	440	265.2054	0	4.83	2.9112		54.4	1590
3/15/84		3.16	2150	629		0	3.13			74.4	2002
5/23/84	200	3	1800	400	964.3835	0	6	14.4657		49.6	1646
9/7/84	80	3.01	1900	442	426.2575	0	3.66	3.5296		42.3	1450
11/8/84	10	3.2	1400	355	42.7945	0	22.8	2.7484		28.8	1279
3/1/85	225	3.06	2580	615	1668.0821	0	5.08	13.7786		51.2	1775
5/13/85		2.94	2800	371		0	25.1			62.9	2364
7/2/85	175	2.95	1800	529	1115.9726	0	9.56	20.1676		43.6	1810
8/27/85	15	3.31	1750	449	81.189	0	26.4	4.7736		31.7	1233
11/15/85	20	3.09	2600	467	112.5917	0	40.1	9.6679		45.1	1818
1/16/86	10	3.08	2440	755	91.0136	0	9.14	1.1018		52.6	1989
3/21/86		2.95	3400	666		0	5.67			51.5	1954
4/30/86		2.84	3140	598		0	4.78			41.8	2041
7/18/86		3	3400	800		0	5.01			66	2475
8/29/86		3.02	2500	432		0	5.83			39.9	1462
3/14/88	36	3.27	2000	410	177.9287	0	3.86	1.6751		27.9	1551
6/1/88	19	3.3	2450	329	75.3545	0	5.8	1.3284		24.6	1460
8/4/88	18	3.24	2300	274	59.4542	0	15.7	3.4066		17.3	1336
10/31/88	35	3.18	2600	320	135.0136	0	19.2	8.1008		23.4	1306
2/14/89	22	3.5	3500	370	98.126	0	25.6	6.7892		23.3	1688
4/27/89	89	3.53	3500	458	491.3775	0	2.14	2.2959		47.2	2607
8/3/89	97	3.46	3950	518	605.7052	0	0.99	1.1576		54.8	2567
11/29/89	9	3.25	2800	387	41.9868	0	28.2	3.0595		32.4	2090
2/9/90	132	3.45	3340	264	420.0854	0	6	9.5473		35.8	2917
6/5/90	55	3.24	3100	441	292.389	0	2.51	1.6641		37	2897
8/7/90	61	3.26	3600	259	190.4536	0	3.58	2.6325		47.1	3224
11/29/90	36	3.39	4400	330	143.2109	0	5.57	2.4172		50.8	2834
1/23/91	185	3.45	4690	531	1184.2027	0	2.61	5.8206		93.2	4155
4/25/91	157	3.43	4000	474	897.0936	0	4.56	8.6302		75.3	3474
8/19/91	12	3.24	2400	357	51.6427	0	10.5	1.5189		55.1	2091
3/12/92	14	3.15	2900	296	49.955	0	31.9	5.3836		42.8	1940
6/29/92	4	3.06	2900	479	23.0969	0	43.6	2.1023		39.5	1868
9/29/92	35	3.07	2800	385	162.4383	0	40	16.8767		50.4	2260
12/5/92	11	3.2	2900	313	41.5046	0	21.5	2.8509		40.6	1729
12/28/92	25	3.37	3300	467	140.7397	0	44.3	13.3506		68.2	2701
12/27/94	65	2.85	5500	668	523.4191	0	150	117.5342		120	4391
3/28/95	39	3.25	5220	568	267.0378	0	93.3	43.8637		112	4276
6/28/95	69	3.54	4730	657	546.48	0	81.9	68.1228		105	3624
9/25/95	9	3.53	5500	724	78.549	0	135	14.6465		129	4622

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
1/1/96		3.59	4400	723		0	120			117	4224
3/27/96	645	3.27	4900	792	6158.0712	0	105	816.4109		105	4548
6/13/96	26	3.31	5700	758	237.5758	0	197	61.7446		118	4788
6/26/96	3	3.4	2000	321	11.6087	0	2.41	0.0871		46.5	1794
9/26/96	3	3.4	2000	321	11.6087	0	2.41	0.0871		46.5	1794
11/21/96	3	3.29	2800	325	11.7534	0	2.1	0.0759		43.6	1828
11/21/96	3	3.29	2800	325	11.7534	0	2.1	0.0759		43.6	1828
1/8/97	2	3.3	3580	459	11.0663	0	4.83	0.1164		64.2	2717
1/8/97	2	3.3	3580	459	11.0663	0	4.83	0.1164		64.2	2717
4/21/97	2	3.34	3300	413	9.9572	0	1.18	0.0284		64.2	2449
4/21/97	2	3.34	3300	413	9.9572	0	1.18	0.0284		64.2	2449
8/7/97	1	3.37	3000	423	5.0991	0	62.7	0.7558		64.4	2535
8/7/97	1	3.37	3000	423	5.0991	0	62.7	0.7558		64.4	2535
10/13/97	1	3.44	4500	597	7.1967	0	1110	13.3808		78	3326
10/13/97	1	3.44	4500	597	7.1967	0	110	1.326		78.8	3326
2/6/98	2	3.3	3900	722	17.4071	0	1.89	0.0455		104	3597
5/11/98	9	3.34	3200	545	59.1287	0	0.9	0.0976		80.5	2924
7/10/98	2	3.21	3970	622	14.9961	0	6.81	0.1641		124	3559
10/7/98	1	3.51	5000	765	9.2219	0	145	1.7479		93.1	4275
2/5/99	5	3.32	2600	354	21.3369	0	3.97	0.2392		56.9	2332
5/3/99	6	3.27	3650	780	56.4164	0	1.29	0.0933		88.7	3164
7/5/99	3	3.37	2800	476	17.2142	0	1.77	0.064		82.8	3515
10/6/99	1	3.38	3800	564	6.7989	0	60.9	0.7341		79.1	3263
1/26/00	2	3.46	1800	292	7.04	0	5.46	0.1316		54.1	2945
4/12/00	7	3.36	1900	616	51.9802	0	1.87	0.1577		78.3	3484
7/21/00	3	3.36	1600	588	21.2646	0	0.84	0.0303		65.6	3274
11/9/00	3	3.5	4600	556	20.1073	0	0.39	0.0141		45.5	3168
1/18/01	2	3.5	2200	415	10.0054	0	2.49	0.06		48.4	2882
4/26/01	21	3.4	5000	628	158.9786	0	0.81	0.205		66.1	3814
8/2/01	2	3.5	6000	297	7.1605	0	0.34	0.0081		25.4	4151
2/19/02	3	3.6	6800	275	9.9452	1	0.36	0.013		31.6	3179
6/3/02	32	3.5	6000	521	200.9775	1	0.99	0.3818		88.1	4286
9/9/02	2	3.4	5000	452	10.8975	1	0.41	0.0098		43.7	4350
12/9/02	2	3.5	4000	318	7.6668	1	0.29	0.0069		30	3515

TB-22

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/24/82		3.92	800	103		0	0.08			15.1	521
6/21/82		3.49	800	76		0	0.18			13.5	158
2/24/83		4.28	1100	133		0	0.13			22.1	695
5/26/83		4.48	750	62		0	0.05			11.6	397
8/19/83		4.16	950	103		0	0.52			16.5	580
6/5/84		4.24	430	53		0	0.1			9.44	343
5/20/85		4.36	737	75		0	0.05			10.6	370
8/22/85		4.29	1000	184		0	0.44			15.5	491
11/26/85		4.21	500	180		0	0.14			16.9	328
3/5/86		4.48	500	59		2	0.02			8.1	277
5/30/86		4.44	200	66		2	0.18			10.6	38
3/14/88		4.42	647	80		2	0.06			10.9	305
6/1/88		4.48	590	64		2	0.07			10.4	286
8/9/88		4.43	840	73		2	0.2			13.5	374
10/31/88		4.51	850	19		2	0.14			15.9	431
8/3/89		4.38	650	84		1	0.41			10.6	327
11/29/89		4.5	750	80		3	0.19			14.1	473
2/7/90		4.9	600	44		5	0.54			8.3	259
1/21/91		4.21	750	48		0	0.06			6.97	330
4/25/91		4.37	500	82		0	0.09			8.74	333
8/19/91		4.25	700	95		0	0.16			13.7	423
12/6/91		4.13	850	99		0	0.11			13.9	382
3/12/92		4.58	600	50		0	0.14			10.1	292

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/30/92		4.37	700	89		0	0.25			11.9	398
9/29/92		4.17	800	65		0	0.26			13.3	473
12/28/92		4.58	750	35		1	0.18			8.55	217
9/26/96		4.21	340	20		3	0.51			6.66	155
11/21/96		4.32	780	48		5	0.09			7.87	276
1/8/97		4.38	480	47		5	0.03			7.23	234
4/21/97		4.38	430	44		6	0.07			6.74	222

TB-23

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4

TB-26

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
12/9/82		4.7	380	11		3	0.05			1.1	162
2/24/83		5.14	190	7		1	0.05			0.34	70
5/26/83		5.27	160	4		1	0.05			0.28	57
6/5/84		5.03	90	11		1	0.05			0.25	60
4/10/85		5.64	75	4		10	0.02			0.28	62
5/20/85		5.88	157	12		2	0.11			0.28	54
11/21/85		4.77	1400	28		2	0.12			0.29	73
3/5/86		4.76	120	13		2	0.02			0.21	53
5/30/86		5.14	150	8		3	0.05			0.22	54
8/8/86		5.43	180	8		6	0.35			0.42	52
3/14/88		4.72	140	11		2	0.02			0.35	63
6/1/88		5.85	110	3		6	0.08			0.33	59
8/9/88		5.63	210	3		5	0.46			0.3	70
10/31/88		4.74	280	2		2	0.27			0.98	104
2/14/89		4.95	280	11		3	0.24			0.42	82
5/2/89	1	4.72	195	18	0.2169	2	0.14	0.0016		0.32	81
8/3/89	1	5.46	190	16	0.1928	5	1.22	0.0147		0.35	69
11/29/89	1	4.78	220	10	0.1205	2	6.53	0.0787		0.46	92
2/7/90	5	5.12	160	7	0.4219	3	0.37	0.0223		0.33	60
6/5/90	1	5.71	145	3	0.0361	4	0.3	0.0036		0.27	62
8/7/90	1	6.05	160	4	0.0482	4	0.16	0.0019		0.36	66
11/29/90	1	5.35	195	5	0.0602	2	0.05	0.0006		0.22	60
1/23/91	4	5.78	260	4	0.1928	3	0.06	0.0028		0.18	57
4/25/91		5.17	140	6		1	0.05			0.17	56
8/19/91		6.92	200	4		22	3.34			0.25	62
12/6/91		5.2	165	9		2	0.19			0.29	52
3/12/92	1	4.68	160	8	0.0964	1	0.08	0.0009		0.19	60
11/21/96		4.94	180	5		6	0.06			0.2	42
8/7/97		5.87	180	3		11	5.37			0.37	49

TB-29

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/24/82	800	4.71	140	21	202.5205	0	0.05	0.4821		0.33	55
6/21/82		3.49	190	33		0	0.05			0.83	83
12/9/82	15	4.94	220	7	1.2657	2	0.05	0.009		1.55	95
2/24/83	18	5.15	180	7	1.5189	3	0.05	0.0108		0.56	71
5/26/83	9	5.12	180	5	0.5424	0	0.05	0.0054		0.47	68
8/19/83	10	6.29	230	6	0.7232	4	0.16	0.0192		2.11	92
12/15/83	15	5.01	110	7	1.2657	0	0.05	0.009		0.31	72
3/14/84		4.96	410	6		0	0.09			0.25	67

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/5/84	60	4.46	130	13	9.4027	0	0.1	0.0723		0.97	90
9/6/84		4.53	460	13		0	0.2			1.8	84
11/8/84	2	5.47	100	9	0.2169	2	0.16	0.0038		0.55	60
3/4/85	70	4.73	190	10	8.4383	0	0.02	0.0168		0.95	85
5/15/85		4.63	190	16		1	0.7			1.26	100
11/21/85	10	4.8	170	19	2.2904	2	0.19	0.0229		0.96	70
1/16/86	5	4.87	190	32	1.9287	2	0.1	0.006		1.38	96
5/30/86	2	4.74	200	15	0.3616	2	0.08	0.0019		1.21	91
8/8/86	1	3.73	850	30	0.3616	0	0.48	0.0057		4.99	215
3/14/88	11	4.21	280	52	6.8953	0	0.1	0.0132		4.93	181
6/1/88	3	4.09	450	59	2.1336	0	0.36	0.013		5.52	200
10/31/88	1	5.05	300	12	0.1446	3	0.61	0.0073		2.6	104
2/14/89	8	4.8	340	20	1.9287	3	0.09	0.0086		1.38	97
5/2/89	23	4.73	210	13	3.6043	2	0.2	0.0554		1.1	78
8/3/89	4	4.77	240	15	0.7232	3	0.33	0.0159		1.68	88
11/29/89	2	4.83	260	10	0.241	3	0.36	0.0086		1.25	93
2/9/90	31	4.68	215	17	6.3528	2	0.05	0.0186		0.95	87
6/5/90	4	4.73	210	18	0.8679	3	0.21	0.0101		1.27	96
8/7/90	5	4.5	270	13	0.7835	1	0.25	0.015		1.33	103
11/29/90	5	4.52	280	21	1.2657	0	0.1	0.006		1.07	87
1/23/91	24	4.7	180	11	3.1824	2	0.09	0.026		0.79	70
4/25/91	102	4.78	150	9	11.0663	0	0.08	0.0983		0.52	58
12/5/91	41	4.75	200	11	5.4367	0	0.19	0.0939		0.88	69
3/18/92	22	4.79	180	19	5.0389	1	0.14	0.0371		1.25	90
6/30/92	1	5.61	225	8	0.0964	4	0.12	0.0014		1.18	89

TB-29A

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/24/82	50	3.76	180	21	12.6575	0	0.05	0.0301		1.04	72
6/21/82	25	3.12	3900	486	146.4657	0	17.8	5.3643		106	3057
9/7/82	5	4.25	2500	203	12.2356	0	0.75	0.0452		66.7	1662
12/9/82	20	4.16	500	34	8.1972	0	0.7	0.1687		7.79	255
2/24/83	40	4.46	420	35	16.8767	0	0.09	0.0433		3.9	178
5/26/83	375	4.6	250	18	81.3698	0	0.1	0.452		1.49	98
8/19/83	25	4.29	350	21	6.3287	0	0.12	0.0361		6.41	158
12/18/83	50	4.49	170	28	16.8767	0	0.11	0.0663		1.9	113
3/18/84		4.46	190	30		0	0.05			2.54	126
6/5/84	75	4.48	130	20	18.0821	0	0.08	0.0723		1.45	102
9/7/84	12	4.13	210	46	6.6542	0	0.34	0.0491		3.97	126
11/8/84	6	4.41	180	26	1.8805	0	0.27	0.0195		4.54	117
3/1/85	175	4.4	170	16	33.7534	0	0.05	0.1054		1.03	81
5/15/85	25	4.37	200	27	8.1369	0	0.41	0.1235		1.93	106
11/21/85	50	4.46	220	34	20.4931	1	0.13	0.0783		1.88	92
1/16/86	5	4.4	237	62	3.7369	1	0.17	0.0102		2.2	119
5/30/86	15	4.24	220	26	4.7013	0	0.08	0.0144		1.6	93
8/8/86	5	4.07	240	32	1.9287	0	0.42	0.0253		3.66	107
3/14/88	44	4.46	160	38	20.1556	1	0.03	0.0159		1.2	79
6/1/88	29	4.45	150	30	10.4876	1	0.03	0.0104		1.54	76
10/31/88	2	4.41	400	11	0.2652	1	0.33	0.0079		5.31	155
2/14/89		4.62	310	34		2	0.19			1.51	100
5/2/89	44	4.45	230	31	16.4427	1	0.21	0.1113		1.24	91
8/3/89	9	4.32	250	35	3.7972	0	0.33	0.0358		2.92	112
11/29/89	9	4.38	280	47	5.0991	1	0.35	0.0379		2.96	124
2/9/90	190	4.52	220	28	64.1315	2	0.04	0.0916		0.97	79
6/5/90	17	4.37	205	25	5.1232	0	0.11	0.0225		1.43	93
8/7/90	14	4.29	240	21	3.5441	0	0.58	0.0978		1.97	95
11/29/90	20	4.52	240	37	8.9205	1	0.13	0.0313		1.32	78
1/23/91		4.27	230	20		0	0.12			0.91	68
4/25/91	208	4.55	145	13	32.5961	0	0.1	0.2507		0.6	56
12/5/91	93	4.44	235	24	26.9063	0	0.52	0.5829		1.56	79

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/18/92	47	4.79	170	7	3.966	1	0.31	0.1756		1.18	80
6/30/92	3	4.47	180	19	0.6871	0	0.1	0.0036		2.01	72

TB-30

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/21/82	50	3.08	1500	200	120.5479	0	4.2	2.5315		32.6	969
9/7/82	15	3.59	3500	347	62.7452	0	6.39	1.1554		101	2305
12/9/82	50	3.79	800	80	48.2191	0	0.38	0.229		16.6	457
2/24/83	55	4.06	650	66	43.7589	0	0.23	0.1524		10.8	330
5/26/83	400	4.27	410	26	125.3698	0	0.16	0.7715		3.37	151
8/19/83	45	4.09	490	29	15.7315	0	0.14	0.0759		8.76	230
12/15/83	125	4.3	260	35	52.7397	0	0.21	0.3164		3.72	161
3/15/84		4.43	230	31		0	0.06			3.74	152
6/5/84	90	4.31	165	22	23.8684	0	0.13	0.141		2.13	124
9/7/84	15	4.34	210	42	7.5945	0	0.23	0.0415		4.13	127
11/8/84	10	4.27	240	27	3.2547	0	0.2	0.0241		6.02	154
3/1/85	225	4.37	200	17	46.1095	0	0.03	0.0813		1.67	99
5/15/85	30	4.32	220	28	10.126	0	0.46	0.1663		2.13	110
11/21/85	75	4.33	250	33	29.8356	1	0.11	0.0994		2.38	103
1/16/86	5	4.35	250	37	2.2301	1	0.11	0.0066		2.62	127
5/30/86	16	4.28	215	27	5.2076	0	0.11	0.0212		1.79	98
8/8/86	5	4.1	270	31	1.8684	0	0.35	0.021		3.75	111
3/14/88	60	4.41	180	34	24.5917	1	1.63	1.1789		1.63	86
6/1/88	33	4.42	160	27	10.7408	1	1.77	0.7041		1.77	79
10/31/88	3	4.5	380	36	1.3019	2	5.63	0.2036		5.63	164
2/14/89		4.44	370	34		1	2.03			2.03	109
5/2/89	54	4.36	286	34	22.1326	0	2.18	1.419		2.18	114
8/3/89	10	4.29	270	37	4.4602	0	3.07	0.37		3.07	111
11/29/89	10	4.73	290	48	5.7863	1	3.47	0.4183		3.47	144
2/9/90	216	4.43	305	29	75.5112	1	1.33	3.4631		1.33	104
6/5/90	20	4.42	230	28	6.7506	1	1.72	0.4146		1.72	106
8/7/90	17	3.78	330	23	4.7134	0	2.53	0.5184		2.53	129
11/29/90	23	4.48	225	50	13.863	0	1.49	0.4131		1.49	78
1/23/91		4.23	260	26		0	1.77			1.77	112
4/25/91	235	4.47	180	28	79.3205	0	1	2.8328		1	70
12/5/91	101	4.41	230	23	28.0032	0	1.88	2.2889		1.88	92
3/18/92	53	4.5	185	42	26.8339	0	1.5	0.9583		1.5	90
6/30/92	3	4.43	200	22	0.7956	0	2.18	0.0788		2.18	73

TB-32

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
7/11/83		2.75	2860	741		0	26			71.2	2040
11/15/83		2.79	1800	1150		0	81.4			105	2490
2/20/84	250	2.85	1850	592	1784.1095	0	30.8	92.8219		80.8	1634
5/23/84	275	2.86	1600	471	1561.3972	0	23.6	78.2356		77.7	1451
8/13/84	266		2000								
8/14/84	411		1950								
8/15/84	411	2.79	2150	515	2551.578	0	26.48	131.1957		84.5	1844
8/27/84	94		3200								
9/6/84	47	2.82	2400	762	431.7304	0	25.8	14.6176		102	2046
9/10/84	23		2400								
9/14/84	23	2.75	2400	881	244.2663	0	25.98	7.2032		94.8	2518
9/26/84	16		2600								
10/4/84	16		2500								
10/10/84	8	2.96	2450	782	75.4147	0	32.9	3.1728		103	2656
10/23/84	20		2500								
11/5/84	23	2.93	2600	1002	277.8147	0	37.7	10.4527		116	2287

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/29/84		3.03	1650	410		0	19.2			61.7	1341
12/11/84	82		1800								
12/21/84	130		2100								
1/14/85	64		2000								
2/1/85	64		1800								
2/22/85	82		1800								
2/26/85	357	2.83	1900	826	3554.7419	0	26.3	113.1836		93.2	1805
3/13/85	190		750								
3/20/85	106	2.92	2400	487	622.2926	0	18.1	23.1283		81.7	1438
4/7/85	357		1650								
5/13/85	82	2.9	2150	527	520.9358	0	46.4	45.866		80	1669
5/27/85			1900								
6/17/85	23		1900								
7/11/85		2.73	2900	639		0	27.7			78.7	1909
8/22/85	8	2.58	3060	846	81.5868	0	25.4	2.4495		81.3	1340
9/16/85		2.57	2930	824		0	23.1			85.4	1983
10/13/85	47		1750								
11/15/85	82	2.79	2200	832	822.4263	0	28.7	28.3697		86	2026
12/9/85	193	2.83	2800	586	1363.3731	0	25	58.1643		82.8	1441
1/13/86	702	2.74	2900	828	7006.9216	0	26.4	223.409		96	2051
1/16/86	34.2	2.77	2560	855	352.4942	0	26.3	10.8428		102	1989
3/14/86	498	2.84	1800	492	2953.6175	0	7.73	46.4054		60.5	1041
5/12/86	82	2.82	2270	647	639.555	0	12.6	12.455		71.9	1435
5/30/86	313	2.93	2000	547	2063.9134	0	13.9	52.4467		65.2	1389
6/10/86	114	2.85	1600	421	578.5578	0	15.8	21.713		67.9	1348
7/16/86	200	2.7	1700	666	1605.6986	0	13.3	32.0657		72	1493
8/8/86	150	2.83	2870	493	891.452	0	17.7	32.0054		91.1	1750
9/11/86	55	3.06	2960	691	458.1424	0	15.8	10.4756		78.9	1852
3/14/88	390	2.88	2330	663	3117.0082	0	17.5	82.2739		66	1183
6/1/88	400	2.94	2360	598	2883.5068	0	16.1	77.6328		65.8	1303
8/9/88	15	2.95	3200	728	131.6383	0	22.5	4.0684		86	1788
10/31/88	65	2.91	3320	783	613.5287	0	27.5	21.5479		106	2134
2/14/89	180	2.96	4000	726	1575.3205	0	20.5	44.4821		78.4	1892
5/2/89	245	3.02	3470	825	2436.5753	0	20.3	59.9545		86.7	1968
8/3/89	107	3.06	2700	818	1055.1079	0	15.2	19.6059		83.6	1703
11/29/89	62	2.97	3100	1040	777.2931	0	25	18.6849		93.2	2365
2/9/90		3.03	2550	663		0	14.7			59.3	1503
6/5/90	214	2.95	2200	555	1431.7479	0	14.2	36.6321		62.6	1768
8/7/90	139	2.98	2450	439	735.5956	0	11.1	18.5993		63.7	1784
11/29/90	115	3.02	2050	458	634.926	0	13.8	19.1309		63.7	1665
1/23/91	573	3.17	2000	470	3246.4767	0	9.38	64.7913		53.1	1411
4/25/91	862	3.1	1750	460	4779.9671	0	10.1	104.9514		48.2	1318
8/19/91	34	2.88	2100	560	229.5232	0	16	6.5578		83.5	1985
12/5/91	299	2.77	3000	704	2537.486	0	16.6	59.8327		85.4	1480
3/18/92	288	2.89	2500	422	1465.0915	0	13	45.1331		63.8	1401
6/30/92	165	3.03	2600	610	1213.315	0	13.1	26.0564		66.2	1787
9/29/92	115	2.93	2600	524	726.4219	0	15.3	21.2104		80.5	1951
12/28/92	150	3	2000	435	786.5753	0	13.4	24.2301		57.7	1368
10/3/94	138	3.16	1800	352	585.5736	0	9.64	16.0367		64.4	1634
12/27/94	145	2.99	2000	313	547.1068	0	10.9	19.0526		50.8	1401
3/28/95	110	3.07	1600	290	384.5479	0	7.98	10.5816		42.8	1227
6/28/95	185	3.06	1475	326	727.0246	0	3.79	8.4522		43	1153
3/27/96	21	3.35	1000	148	37.4663	0	6	1.5189		21.8	631
6/13/96	17	3.29	1900	202	41.3961	0	7.58	1.5533		35.9	1061
9/26/96	58	3.26	1800	256	178.9895	0	6.26	4.3768		41.5	1215
9/26/96	58	3.26	1800	256	178.9895	0	6.26	4.3768		41.5	1215
11/21/96	75	3.18	1700	247	223.315	0	5.12	4.629		36.2	1080
11/21/96	75	3.18	1700	247	223.315	0	5.12	4.629		36.2	1080
1/8/97	69	3.22	1600	278	231.235	0	6.83	5.681		39.5	1142
1/8/97	69	3.22	1600	278	231.235	0	6.83	5.681		39.5	1142
4/21/97	76	3.24	1750	270	247.3643	0	6	5.4969		44.1	1235
4/21/97	76	3.24	1750	270	247.3643	0	6	5.4969		44.1	1235
8/7/97	6	3.12	1700	286	20.686	0	5.56	0.4021		49.7	1418

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
8/7/97	6	3.12	1700	286	20.686	0	5.56	0.4021		49.7	1418
10/13/97	9	3.1	1850	420	45.5671	0	9.59	1.0404		72.3	1672
10/13/97	9	3.1	1850	420	45.5671	0	9.59	1.0404		72.3	1672
2/6/98	67	3.15	1800	363	293.1846	0	7.73	6.2432		50	1307
5/11/98	97	3.19	1550	262	306.3605	0	4.09	4.7824		35.9	873
7/10/98	16	3.14	2480	383	73.8717	0	5.52	1.0646		61.8	1702
9/25/98	11	3.02	2100	383	50.7868	0	6.77	0.8977		106	1632
10/7/98	2	3.05	2600	411	9.909	0	3.38	0.0814		71.5	1682
2/5/99	100	3.01	2000	409	493.041	0	7.34	8.8482		43.9	1451
5/3/99	73.5	3.06	1350	297	263.1501	0	5.12	4.5364		33.3	1008
7/5/99	20	3.13	1600	307	74.0164	0	5.72	1.379		47.7	1537
10/6/99	2	3.05	2100	358	8.6312	0	2.36	0.0568		46.3	1389
1/26/00	16	3.06	1700	331	63.8421	0	9.9	1.9094		45.5	2027
4/12/00	75	3.1	1000	262	236.8767	0	7.84	7.0882		32.6	1158
7/21/00	18	3.12	1000	345	74.8602	0	7.53	1.6339		42.5	1402
11/9/00	14	3	1800	510	86.0712	0	10.8	1.8226		51.7	1584
1/18/01	12	3	1200	467	67.555	0	12.7	1.8371		47.3	1491
4/26/01	188	3.1	1450	363	822.6673	0	7.41	16.7932		30.8	1037
8/2/01	8	3.1	2000	345	33.2712	0	7.82	0.7541		47.8	1525
6/3/02	89	3.1	2000	196	210.2838	1	6.41	6.8771		35.9	1725
12/9/02	14	3	2200	406	68.5194	1	11.9	2.0083		54.1	1652
12/19/02	80	3.1	2800	285	274.8493	1	12	11.5726		40.6	1202

TB-40

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/21/82	4000	3.34	600	68	3278.9041	0	2.32	111.8684		8.29	303
9/7/82		3.57	1000	94		0	3.77			14.8	413
12/9/82	1500	3.87	400	22	397.8082	0	0.94	16.9972		4.58	154
2/24/83	2600	3.77	380	26	814.9041	0	1.49	46.7002		4.05	139
5/26/83	4500	3.59	50	7	379.726	0	2.73	148.0931		7.57	218
8/19/83	2000	3.35	1000	121	2917.2602	0	4.85	116.9315		16.6	545
12/6/83		3.83	360	39		0	2.11			6.51	214
2/20/84		3.84	290	33		0	2.32			6.07	175
5/23/84	4000	3.78	290	36	1735.8904	0	1.95	94.0273		6.27	183
9/8/84	1500	3.29	650	88	1591.2328	0	6.14	111.0246		13.9	407
11/14/84	900	3.8	300	32	347.178	0	3	32.5479		6.27	199
3/1/85	4000	3.6	430	38	1832.3287	0	2.48	119.5835		9.13	229
6/6/85		4.67	320	14		0	1.88			5.84	217
8/22/85	600	2.89	1400	251	1815.452	0	7.51	54.3189		17.7	513
11/26/85		3.64	500	143		0	3.14			7.91	184
1/16/86		3.35	841	93		0	7.35			14.4	466
5/30/86	500	3.55	600	48	289.315	0	2.59	15.6109		8.01	249
8/8/86	1250	3.18	1000	180	2712.3287	0	4.53	68.2602		18.7	543
3/14/88	8100	3.85	280	46	4491.6164	0	2.1	205.052		5.25	150
6/1/88	1700	3.58	600	67	1373.041	0	2.8	57.3808		8.95	249
8/4/88	250	3.2	1300	226	681.0958	0	6.56	19.7698		15.1	604
10/31/88	1260	3.32	1145	169	2566.9479	0	6.57	99.792		16	494
2/14/89		3.75	850	47		0	5.78			7.9	259
4/27/89	2730	3.65	775	66	2172.0328	0	2.81	92.4759		12.3	466
8/3/89	1355	3.45	1250	214	3495.5287	0	3.77	61.5801		18.1	658
11/29/89	1650	3.82	500	50	994.5205	0	2.79	55.4942		6.96	249
1/23/90	6850	3.79	700	73	6028	0	2.81	232.0367		9.58	359
2/7/90	11500	4.08	500	42	5822.4657	0	1.84	255.0794		6.29	190
6/5/90	4600	3.54	550	57	3160.7671	0	2.5	138.6301		8.31	316
8/7/90	2485	3.5	700	43	1288.115	0	2.53	75.789		9.46	388
11/29/90	4000	3.64	750	71	3423.5616	0	2.54	122.4767		8.63	318
4/25/91		4.08	480	44		0	1.2			5.66	207
8/19/91	738	3.11	1300	193	1717.0126	0	7.09	63.0757		27.6	947
12/5/91		3.67	410	44		0	1.84			5.08	159
3/12/92		4	360	39		0	1.67			4.59	164

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/30/92	2000	3.39	1100	193	4653.1506	0	3.95	95.2328		16	611
9/29/92	2000	3.82	700	33	795.6164	0	2.57	61.9616		8.38	301
12/28/92	2000	3.79	700	65	1567.1232	0	3.37	81.2493		9.72	339
10/3/94	745	4.07	530	20	179.6164	3	2.51	22.5418		7.49	259
12/27/94	2000	3.96	800	24	578.6301	1	3.85	92.8219		5.9	267
3/28/95	1460	4.67	560	10	176	6	1.1	19.36		3	143
6/28/95	3100	3.18	1150	177	6614.4657	0	9.24	345.2975		27.5	738
9/25/95	260	3.03	1600	243	761.6219	0	29	90.8931		42.1	1122
3/27/96		3.43	1100	119		0	4.15			15.6	500
6/13/96	840	3.29	1750	179	1812.5589	0	14	141.7643		32.2	934
9/26/96	2154	3.77	700	66	1713.7578	0	3.35	86.9861		11.4	469
9/26/96	2154	3.77	700	66	1713.7578	0	3.35	86.9861		11.4	469
11/21/96	2513	3.59	720	66	1999.3841	0	4.17	126.3247		11.2	440
11/21/96	2513	3.59	720	66	1999.3841	0	4.17	126.3247		11.2	440
1/8/97	463	3.85	580	64	357.2076	0	4.19	23.3859		9.28	355
1/8/97	463	3.85	580	64	357.2076	0	4.19	23.3859		9.28	355
4/21/97	2388	3.7	630	53	1525.703	0	4.32	124.3591		11.7	459
4/21/97	2388	3.7	630	53	1525.703	0	4.32	124.3591		11.7	459
8/7/97	62	3.15	1550	149	111.3621	0	9.53	7.1226		28.3	962
8/7/97	62	3.15	1550	149	111.3621	0	9.53	7.1226		28.3	962
10/13/97	350	3.39	1150	119	502.0821	0	5.86	24.7243		24.4	731
10/13/97	350	3.39	1150	119	502.0821	0	5.86	24.7243		24.4	731
2/6/98	1791	3.76	780	82	1770.3912	0	3.33	71.8951		11	468
5/11/98	7539	4.01	600	38	3453.4816	2	1.6	145.4097		7.26	309
7/10/98	350	3.31	1200	204	860.7123	0	4.31	18.1846		21.3	988
10/7/98	241	3.2	1750	222	644.9556	0	7.68	22.3119		21.9	937
2/5/99	5386	4.32	380	24	1558.2509	4	1.23	79.8603		3.33	161
5/3/99	1812	3.75	820	77	1681.9331	0	2.16	47.1815		9.55	459
7/5/99	282	3.22	1000	100	339.9452	0	3.74	12.7139		12.3	635
10/6/99	233	3.78	760	31	87.0717	0	9.77	27.4416		7.66	360
1/26/00		3.67	610	47		0	9.42			7.34	379
4/12/00	1206	3.98	460	31	450.6805	2	2.71	39.3982		5.88	279
7/21/00	650	3.38	1000	139	1089.1506	0	4.9	38.3945		18.8	799
11/9/00	879	3.6	900	55	582.789	0	3.53	37.4044		102	398
1/18/01		3.7	680	35		0	6.26			8.36	355
4/26/01	2468	4	770	49	1457.8104	4	1.43	42.5442		6.52	387
8/2/01	187	3.4	1200	93	209.6449	0	8.68	19.5668		15.1	748
2/19/02	107	4.2	880	18	23.2175	5	2.2	2.8376		4.46	183
6/3/02	897	3.7	1500	86	929.9309	1	2.76	29.8442		17.3	806
9/9/02		3.2	1700	140		1	5.49			22.6	1137
12/9/02		3.8	920	36		1	6.54			9.54	401

TB-41

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/7/82	100	3.4	1500	133	160.3287	0	8.24	9.9331		20.1	734
12/9/82	20	3.53	500	36	8.6794	0	2	0.4821		7.24	257
2/27/83	700	3.73	450	25	210.9589	0	1.39	11.7293		5.25	172
5/26/83	280	3.85	480	28	94.5095	0	1.27	4.2866		5.24	191
8/19/83	150	3.11	1300	147	265.8082	0	5.36	9.692		16.5	710
12/6/83		3.88	300	43		0	3.05			6.19	170
2/20/84		4.18	240	22		0	1.11			4.26	168
5/23/84	900	4.2	250	19	206.1369	0	1.19	12.9106		4.52	167
9/8/84	500	3.4	700	79	476.1643	0	6.29	37.9123		11	525
11/14/84	400	3.7	420	40	192.8767	0	2.65	12.778		7.99	282
3/1/85	800	3.61	540	30	289.315	0	0.75	7.2328		5.92	229
6/6/85		3.28	600	66		0	4.22			10.2	416
8/22/85	350	2.87	1750	301	1269.9726	0	11.3	47.6767		17.4	1065
11/26/85		3.57	500	130		0	2.69			8.05	201
5/30/86	2500	3.59	700	142	4279.452	0	2.19	66		7.16	382
8/8/86	75	3.14	1500	186	168.1643	0	4.67	4.2221		15.4	614

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/14/88	7600	3.77	340	46	4214.3561	0	2.03	185.9813		4.7	158
6/1/88	1500	3.57	550	54	976.4383	0	2.25	40.6849		6.31	236
8/4/88	400	3.11	1700	265	1277.8082	0	11	53.041		14	891
10/31/88	1875	3.4	1000	133	3006.1643	0	4.96	112.1095		13.5	471
2/14/89		3.97	750	44		0	5.3			6.74	304
4/27/89	1956	3.58	1000	142	3348.2432	0	3.87	91.2514		10.1	467
8/3/89	2900	3.39	1050	200	6991.7808	0	3.65	127.6		12.4	508
11/29/89	2100	3.85	500	47	1189.8082	0	1.94	49.1112		6.28	395
2/7/90		4.65	345	17		2	1.06			3.21	150
6/5/90	8000	3.57	500	43	4146.8493	0	1.85	178.4109		5.25	254
8/7/90	2900	3.36	650	37	1293.4794	0	2.88	100.6816		7.47	299
11/29/90	5000	3.65	600	53	3194.5205	0	1.95	117.5342		5.34	267
1/23/91		3.84	480	48		0	2.29			4.6	238
4/25/91		4.03	360	34		0	1.06			2.85	151
8/19/91	703	3.13	1000	171	1449.143	0	7.87	66.6944		14.3	672
12/5/91		3.82	700	27		0	1.93			3.51	189
3/12/92		3.75	370	49		0	1.73			3.84	180
6/30/92	750	3.38	1080	187	1690.6849	0	3.91	35.3506		10	596
9/29/92	1500	3.57	625	82	1482.7397	0	3.12	56.4164		6.26	287
12/28/92	2000	3.82	600	47	1133.1506	0	3.54	85.3479		5.73	275
10/3/94	2300	3.67	670	33	914.9589	0	4.29	118.9446		6.7	315
12/27/94	2100	0.96	740	20	506.3013	1	1.9	48.0986		4.74	165
3/28/95	2240	3.67	700	38	1026.1041	10	2.74	73.9875		6.08	350
6/28/95	2100	4.57	900	15	379.726	6	1.69	42.7824		4.8	188
1/1/96		4.84	420	17		8	0.61			1.56	114
3/27/96		3.27	1800	231		0	12.3			11.5	1171
6/13/96		3.88	1175	50		0	0.36			7.92	333
9/26/96	3446	3.8	460	38	1578.5512	0	2.24	93.0514		5.18	256
9/26/96	3446	3.8	460	38	1578.5512	0	2.24	93.0514		5.18	256
11/21/96	1212	3.43	1100	59	862.0142	0	5.93	86.6397		7.62	600
11/21/96	1212	3.43	1100	59	862.0142	0	5.93	86.6397		7.62	600
1/8/97	2142	3.73	520	64	1652.5676	0	3.41	88.0508		5.31	350
1/8/97	2142	3.73	520	64	1652.5676	0	3.41	88.0508		5.31	350
4/21/97	942	3.39	1350	134	1521.6526	0	7.03	79.8299		8.37	822
4/21/97	942	3.39	1350	134	1521.6526	0	7.03	79.8299		8.37	822
8/7/97	132	3.37	1150	69	109.795	0	3.01	4.7896		9.67	514
8/7/97	132	3.37	1150	69	109.795	0	3.01	4.7896		9.67	514
10/13/97	190	3.48	830	91	208.4273	0	4.44	10.1694		12	559
10/13/97	190	3.48	830	91	208.4273	0	4.44	10.1694		12	559
2/6/98	1024	3.9	475	34	419.6997	0	2.12	26.1695		4.67	248
5/11/98	3678	3.92	500	32	1418.801	0	1.56	69.1665		3.85	234
7/10/98	292	3.42	820	65	228.8	0	2.81	9.8912		8.62	486
10/7/98	161	3.32	1200	165	320.2356	0	3.87	7.5109		12.2	631
2/5/99	5409	4.16	325	25	1630.1095	3	1.02	66.5084		2.57	152
5/3/99	1711	3.82	530	46	948.7846	0	1.64	33.8262		4.47	259
7/5/99	302	3.39	680	88	320.3682	0	2.63	9.5746		6.74	371
10/6/99	360	3.65	700	59	256.0438	0	2.44	10.5889		7.13	326
1/26/00		3.84	470	42		0	2.28			5.4	368
4/12/00	1077	3.97	360	21	272.6432	0	1.13	14.6708		3.37	211
7/21/00	730	3.4	700	63	554.4	0	4.59	40.392		10.4	473
11/9/00	538	3.7	880	55	356.7013	0	2.35	15.2408		9.05	368
1/18/01		3.7	520	39		0	2.33			6.38	309
4/26/01	1077	4.1	470	23	298.6093	3	1.1	14.2813		3.64	197
8/2/01	161	3.4	1000	63	122.2717	0	3.84	7.4527		9.37	542
2/19/02		3.9	600	16		0	1.58			3.54	174
6/3/02		3.9	740	24		0	1.35			5.2	497
9/9/02		3.3	1600	120		0	5.33			19	1056
12/9/02		4	970	34		2	6.22			9.49	381

TB-42

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/21/82	3000	2.95	340	13	470.1369	0	3.09	111.7479		3.05	153
9/7/82		3.09	875	91		0	2.56			8.79	440
12/9/82	1200	5.46	240	2	28.9315	0	0.71	10.2706		1.47	75
2/24/83	2800	3.55	500	24	810.0821	0	4.12	139.0641		3.89	183
5/26/83	3200	4.26	260	2	77.1506	0	1.76	67.8926		1.78	90
8/19/83	1500	3.02	1100	198	3580.2739	0	2.15	38.8767		8.7	460
12/6/83		4.83	220	9		0	2.77			2.72	109
2/20/84		5.89	140	7		0	1.4			1.82	82
5/23/84	3000	3.96	170	14	506.3013	0	2.74	99.0904		2.12	108
9/7/84	1000	2.94	700	162	1952.8767	0	17.8	214.5753		8.86	461
11/14/84	900	3.82	350	38	412.2739	0	7.8	84.6246		4.79	218
3/4/85	3000	4.45	230	11	397.8082	0	1.05	37.9726		2.25	95
6/6/85		3.43	390	32		0	6			5.39	242
8/22/85	550	2.68	1500	315	2088.4931	0	26.3	174.3726		14	618
11/26/85		5.28	240	7		0	1.17			2.04	74
5/30/86	2100	5.6	250	3	75.9452	0	0.58	14.6827		1.89	93
8/8/86	1000	4.46	300	13	156.7123	0	1.13	13.6219		3.89	163
3/14/88	8000	5.16	200	8	771.5068	3	0.5	48.2191		1.47	67
6/1/88	1400	5.2	190	5	84.3835	3	0.71	11.9824		2.04	82
8/4/88	150	4.15	550	22	39.7808	1	3.07	5.5512		3.7	185
10/31/88	675	4.44	500	18	146.4657	1	3.05	24.8178		5.17	200
2/14/89	3000	4.89	500	10	361.6438	3	1.1	39.7808		2.16	101
4/27/89	1743	4.81	385	10	210.115	2	0.88	18.4901		2.75	128
8/3/89	885	4.66	440	11	117.3534	2	1.54	16.4294		4.2	175
11/29/89	1150	5.35	300	5	69.315	3	0.99	13.7243		2.6	130
2/7/90	8400	5.1	230	8	810.0821	3	0.32	32.4032		1.44	86
6/5/90	3562	3.89	230	11	472.3309	0	0.65	27.9104		2.07	112
8/7/90	1900	4.99	400	7	160.3287	2	1.04	23.8202		3.57	171
11/29/90	2800	4.87	365	11	371.2876	2	0.84	28.3528		2.63	147
1/23/91	4872	4.87	340	13	763.5024	2	0.74	43.4609		2.23	127
4/25/91	7840	4.98	260	7	661.5671	1	0.38	35.9136		1.58	87
8/19/91	491	3.92	550	47	278.1884	0	2.46	14.5605		6.69	259
12/5/91	6100	5.06	280	9	661.8082	1	0.55	40.4438		1.96	93
3/12/92	7270	5.09	250	10	876.3835	1	0.47	41.19		1.96	95
6/30/92	2000	4.29	490	21	506.3013	0	1.43	34.4767		4.26	327
9/29/92	2000	4.46	400	10	241.0958	1	1.08	26.0383		3.42	137
12/28/92	2000	4.85	350	12	289.315	2	0.65	15.6712		3.08	144
10/3/94	259	4.06	670	20	62.4438	3	2.77	8.6484		7.49	266
12/27/94	1900	4.05	760	18	412.2739	2	6.5	148.8767		4.15	197
3/28/95	920	4.78	390	9	99.8136	6	1.06	11.7558		2.92	134
6/28/95	2700	5.93	520	5	162.7397	10	0.8	26.0383		2.77	1113
9/25/95	204	5.85	520	10	24.5917	13	4.16	10.2301		6.53	253
1/1/96		4.91	440	16		8	0.45			3.85	191
3/27/96		4.38	380	22		5	0.68			5.1	149
6/13/96	710	3.63	1400	92	787.4191	0	1.19	10.185		3.8	481
9/26/96	980	5.42	320	4	47.2547	6	1.18	13.9401		3.3	154
9/26/96	980	5.42	320	4	47.2547	6	1.18	13.9401		3.3	154
11/21/96	628	5.02	350	7	52.9928	6	0.82	6.2077		3.18	146
11/21/96	628	5.02	350	7	52.9928	6	0.82	6.2077		3.18	146
1/8/97	797	5.1	300	7	67.2536	6	0.78	7.4939		2.58	130
1/8/97	797	5.1	300	7	67.2536	6	0.78	7.4939		2.58	130
4/21/97	802	4.83	290	9	87.0115	7	0.82	7.9277		3	137
4/21/97	802	4.83	290	9	87.0115	7	0.82	7.9277		3	137
8/7/97	108	5.24	530	4	5.2076	8	1.51	1.9658		4.33	239
8/7/97	108	5.24	530	4	5.2076	8	1.51	1.9658		4.33	239
10/13/97	165	5.75	500	9	17.9013	11	1.44	2.8642		4.27	214
10/13/97	165	5.75	500	9	17.9013	11	1.44	2.8642		4.27	214
2/6/98	754	4.91	380	10	90.8931	7	0.73	6.6352		2.66	142
5/11/98	1212	5.45	260	5	73.052	8	0.43	6.2824		1.88	99
7/10/98	188	5.44	580	4	9.0652	8	1.08	2.4476		4.55	280
10/7/98	67	5.67	640	9	7.269	11	2.58	2.0837		4.31	254

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/5/99	942	5.59	280	4	45.4224	7	0.27	3.066		1.29	82
5/3/99	660	5.11	330	6	47.7369	8	0.49	3.8985		2.35	140
7/5/99	179	5.96	425	6	12.9468	12	0.75	1.6183		3.41	207
10/6/99	121	6.13	460	5	7.2931	16	0.76	1.1085		3.04	157
1/26/00		5.01	365	10		7	0.71			2.74	156
4/12/00	969	5.43	240	4	46.7243	8	0.27	3.1538		1.66	100
7/21/00	202	5.57	420	5	12.1753	8	1.33	3.2386		4	223
11/9/00	406	5.6	400	4	19.5769	10	1.15	5.6283		2.99	153
1/18/01		5.6	450	3		12	1.81			3.18	168
4/26/01	1718	5.5	380	5	103.5506	7	0.49	10.1479		2.08	124
8/2/01	121	5.9	520	7	10.2104	20	2.1	3.0631		4.02	188
2/19/02	943	6.7	430	1	11.3676	11	0.47	5.3428		1.54	95
6/3/02	603	6.7	560	2	14.538	12	0.69	5.0156		3.42	157
9/9/02	92	6.6	660	12	13.3084	27	4.32	4.791		4.8	271
12/9/02		6.3	500	3		14	1.16			2.56	151

TB-43

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/21/82	20	2.7	1500	248	59.7917	0	14.6	3.52		35.5	875
9/7/82	10	3.13	2400	331	39.9013	0	39	4.7013		69.6	1363
12/9/82	25	2.98	1700	293	88.3013	0	24.2	7.2931		46.2	1103
2/24/83	350	2.87	1600	343	1447.178	0	23.3	98.3068		37.5	950
5/26/83	1200	2.85	1500	315	4556.7123	0	20.1	290.7616		39.5	885
8/19/83	500	2.81	2300	552	3327.1232	0	24.5	147.6712		66.9	1560
12/6/83	600	3.04	2200	379	2741.2602	0	31	224.2191		45.3	1020
2/20/84		3.04	1000	258		0	21.8			39.3	825
5/23/84	550	3.03	900	208	1379.0684	0	14.5	96.1369		38.2	771
9/7/84	200	2.8	1900	514	1239.2328	0	2.68	6.4613		3.93	1635
11/14/84	80	3.02	1500	419	404.0767	0	39.7	38.286		67.9	1373
3/4/85	110	2.98	1800	323	428.3068	0	20.5	27.1835		53.8	1018
6/6/85		2.97	1200	234		0	14.5			42.4	1100
8/22/85	40	2.57	2400	676	325.9616	0	48.68	23.473		67.9	1484
11/26/85		2.99	1400	335		0	14.2			36.9	514
1/16/86		2.86	2100	596		0	48.4			69.3	1511
5/30/86	300	2.93	1500	375	1356.1643	0	13.9	50.2684		45.5	1029
8/8/86	250	2.76	2000	398	1199.452	0	30.7	92.5205		75.1	1571
3/14/88	600	3.25	840	334	2415.7808	0	13.6	98.3671		32.7	635
6/1/88	490	2.98	1730	362	2138.2794	0	14.8	87.4213		42.8	871
8/4/88	60	2.9	2300	537	388.4054	0	18.2	13.1638		62.4	1295
10/31/88	160	21.9	2510	440	848.6575	0	44.6	86.023		73.7	1376
2/14/89	388	3.16	2400	505	2362.0164	0	26	121.6087		44.7	1033
4/27/89	354	3.18	2200	474	2022.7463	0	18.3	78.0933		54.4	1322
8/3/89	203	2.97	2400	640	1566.1589	0	22.8	55.7944		66.6	1635
11/29/89	220	3.11	1500	456	1209.3369	0	22.3	59.1408		42.2	1087
2/7/90	1582	3.28	1700	190	3623.4301	0	10.2	194.5209		35.9	988
6/5/90	735	2.94	2030	412	3650.4328	0	15.8	139.9923		44.5	1564
8/7/90	395	2.98	1600	214	1018.9917	0	12.5	59.5205		41.9	1176
11/29/90	480	3.08	2100	265	1533.3698	0	15.9	92.0021		38.8	1027
1/23/91	923	3.2	1300	244	2714.8843	0	10.7	119.0543		33.1	924
4/25/91	1715	3.27	1400	205	4238.1643	0	7.14	147.6121		26.4	891
8/19/91	96	2.84	1800	369	427.029	0	27	31.246		66.6	1510
12/5/91	972	3.08	1600	28	328.0832	0	12.2	142.9505		32.1	758
3/12/92	750	3.03	1200	218	1970.9589	0	9.85	89.0547		27.4	656
6/30/92	125	3.09	2620	545	821.2328	0	12.8	19.2876		66.6	1637
9/29/92	75	3.07	1600	281	254.0547	0	13.3	12.0246		43.2	1089
12/28/92	150	3.23	1400	252	455.6712	0	13	23.5068		33.6	858
10/3/94	260	3.13	2000	198	620.5808	0	19.2	60.1775		42.6	1172
12/27/94	182	3.02	1600	204	447.5704	0	18.4	40.369		35.6	931
3/28/95	260	3.21	900	184	576.7013	0	8.23	25.7948		26.1	754
6/28/95	341	3.12	1100	183	752.2553	0	14.5	59.6049		28.7	789

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/25/95	59	3.01	1800	271	192.7441	0	22.5	16.0027		25.4	1251
1/1/96		3.26	1600	240		0	18			39.2	1050
3/27/96	75	3.36	1200	152	137.4246	0	6	5.4246		22	632
6/13/96	59	3.27	1800	202	143.669	0	8.53	6.0668		37	1035
9/26/96	251	3.33	1200	177	535.5583	0	7.38	22.33		28.4	838
9/26/96	251	3.33	1200	177	535.5583	0	7.38	22.33		28.7	838
11/21/96	94	3.31	1100	155	175.6383	0	8.43	9.5524		24.1	737
11/21/96	94	3.31	1100	155	175.6383	0	8.43	9.5524		24.1	737
1/8/97	193	3.36	1000	186	432.743	0	8.21	19.1011		24.1	712
1/8/97	193	3.36	1000	186	432.743	0	8.21	19.1011		24.1	712
4/21/97	172	3.33	1350	160	331.7479	0	7.62	15.7994		28.5	804
4/21/97	172	3.33	1350	160	331.7479	0	7.62	15.7994		28.5	804
8/7/97	24	3.03	1800	217	62.7813	0	15.3	4.4265		45.5	1243
8/7/97	24	3.03	1800	217	62.7813	0	15.3	4.4265		45.5	1243
10/13/97	13	3.14	1800	260	40.7452	0	17.7	2.7738		57.2	1200
10/13/97	13	3.14	1800	260	40.7452	0	17.7	2.7738		57.2	1200
2/6/98	94	3.32	1200	197	223.2306	0	7.06	8		25.8	694
5/11/98	200	3.29	1050	178	429.1506	0	4.74	11.4279		17.4	527
7/10/98	36	3.02	1650	324	140.6071	0	14.7	6.3793		59	1228
10/7/98	11	2.98	2200	399	52.9084	0	22.5	2.9835		50.5	1305
2/5/99	337	3.31	1000	167	678.4317	0	4.57	18.5654		16.8	573
5/3/99	132	3.27	1200	170	270.5095	0	5.15	8.1948		20.7	734
7/5/99	13	3.12	1250	194	30.4021	0	11.9	1.8648		32.8	1051
10/6/99	12	3.25	1000	153	22.1326	0	12.1	1.7503		21.1	596
1/26/00		3.25	1100	173		0	7.23			22.3	845
4/12/00	157	3.36	780	129	244.1457	0	3.7	7.0026		15.5	547
7/21/00	43	3.1	1000	197	102.1161	0	13.9	7.2051		38.8	1328
11/9/00	62	3.1	1350	233	174.1435	0	15.7	11.7341		35.8	991
1/18/01		3.2	1100	188		0	18			29	892
4/26/01	282	3.3	1200	155	526.915	0	5.14	17.4731		18.5	667
8/2/01	29	3	1800	222	77.6087	0	19.9	6.9568		43.9	1334
2/19/02	296	3.3	1800	147	524.5282	0	10.6	37.8231		23.2	721
6/3/02	301	3.2	1400	114	413.6482	0	7.66	27.7942		21.6	982
9/9/02	55	2.9	2400	206	136.5808	0	32.2	21.349		46.9	1567
12/9/02		3.1	1600	205		0	23			34.4	1014

TB-44

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/24/82		3.78	160	19		0	0.05			1.33	54
9/7/82		4.94	270	21		0	0.15			3.44	104
12/9/82		6.2	390	1		54	0.23			2.23	291
8/19/83		4.47	290	28		0	0.14			4.3	128
8/8/86		4.13	600	61		0	0.17			6.9	235
8/9/88		5.75	220	4		8	5			2.39	60
10/31/88		6.65	140	2		16	1.07			2.04	45
2/14/89		4.58	500	46		3	0.4			4.4	166
5/2/89		4.44	455	63		2	1.76			5.76	196
8/3/89		4.53	440	65		3	0.37			5.69	200
2/7/90		5.14	160	11		4	0.17			0.8	54
6/5/90		4.54	420	40		2	0.05			5.01	222
4/25/91		4.36	300	45		1	0.11			3.41	139
12/6/91		6.01	200	24		15	0.31			0.92	51
3/12/92		5.66	250	22		10	0.22			2.81	103

TB-49

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/24/82	750	2.91	1300	266	2404.9315					27.3	621
6/21/82	75	2.99	300	73	66					4.65	100
9/7/82	25	2.81	2400	444	133.8082					73.2	1413
12/9/82	20	2.8	260	638	153.8191					84.3	1982
2/24/83	225	2.73	2600	796	2159.0136					66.8	1640
5/26/83	425	2.75	2100	519	2658.9863					64.2	1470
8/19/83	100	2.82	2500	707	852.2739					83.2	1980
12/15/83	300	2.8	2300	1080	3905.7534					95.3	2190
2/20/84	400	2.89	1650	483	2328.9863					75.6	1494
5/25/84	350	2.83	1600	450	1898.6301					75.7	1404
9/7/84	65	2.85	2300	615	481.8904					98.9	1967
11/8/84	30	2.97	2200	762	275.5726					108	2184
2/26/85	1200	2.85	1800	753	10892.7123					89	1695
5/20/85	120	2.89	2550	445	643.726					71.3	1536
8/22/85	15	3.05	2660	640	115.726					76.2	1531
11/21/85	210	2.78	3000	793	2007.4849					86.5	1564
1/16/86		2.8	2460	729						79.7	1897
5/30/86	25	2.8	1800	469	141.3424					63.6	1428
8/8/86	175	2.83	2560	331	698.2739					85.4	1721
3/14/88	460	3.14	2230	529	2933.4136	0	18.8	104.2498		62.6	1145
6/1/88	420	2.95	2250	518	2622.641	0	15.9	80.5019		61.2	1247
8/9/88	28	3.06	2800	558	188.3441	0	21	7.0882		74.9	1507
10/31/88	75	2.93	2880	536	484.6027	0	31.6	28.5698		92.7	1800
2/14/89	220	3.23	2900	630	1670.7945	0	19.5	51.715		70.9	1456
5/2/89	265	3.15	2630	714	2280.8876	0	20	63.8904		75.4	1526
8/3/89	162	3.05	2550	670	1308.4273	0	18	35.1517		77	1772
11/29/89	90	3.05	2750	901	977.5232	0	26.2	28.4252		81.5	1845
2/9/90	864	3.09	2500	602	6270.0361	0	13.4	139.5655		51.7	1483
6/5/90	316	2.97	2100	536	2041.7928	0	14	53.3304		59.1	1725
8/7/90	181	2.94	2400	390	850.9479	0	12.5	27.2739		59.6	1759
11/29/90	200	3.03	2900	381	918.5753	0	11.1	26.7616		58.4	1763
1/23/91	597	3.3	1900	374	2691.5704	0	9.03	64.9863		47.6	1471
4/25/91	982	3.16	1700	335	3965.6657	0	9.16	108.4343		44	1212
8/19/91	73	2.96	2550	430	378.4	0	15.9	13.992		76.5	1714
12/5/91	419	2.82	3000	563	2843.6898	0	18.4	92.9376		79.9	1763
3/18/92	363	2.93	2300	432	1890.3846	0	12.6	55.1362		57.4	1361
6/30/92	75	2.98	2500	503	454.7671	0	20.9	18.8958		61.1	1531
9/29/92	85	3	2400	419	429.3315	0	15.9	16.292		72	1809
12/28/92	150	3.06	2000	360	650.9589	0	12.8	23.1452		51.3	1305
10/3/94	59	3.14	2630	356	253.1989	0	9.22	6.5575		64.6	1614
12/27/94	162	3	2100	301	587.8158	0	10.7	20.8957		51.7	1346
3/28/95	155	3.08	1450	287	536.2575	0	7.72	14.4247		42.2	1176
6/28/95	240	3.02	1750	338	977.8849	0	6.59	19.0658		42.4	1178
9/25/95	27	3.04	2100	372	121.0783	0	5.97	1.9431		102	1585
1/1/96		3.25	1600	249		0	18			39.8	1120
3/27/96		3.35	1200	148		0	5.96			22.4	618
6/13/96	25	3.28	1800	196	59.0684	0	4.17	1.2567		37.6	1043
9/26/96	62	3.31	1400	219	163.68	0	6.13	4.5815		37.9	1117
9/26/96	62	3.31	1400	219	163.68	0	6.13	4.5815		37.9	1117
11/21/96	90	3.25	1700	211	228.9205	0	5.29	5.7392		33.8	1010
11/21/96	90	3.25	1700	211	228.9205	0	5.29	5.7392		33.8	1010
1/8/97	143	3.29	1400	247	425.7873	0	6.77	11.6703		38.3	1041
1/8/97	143	3.29	1400	241	415.4443	0	6.77	11.6703		38.3	1041
4/21/97	65	3.25	1500	220	172.3835	0	5.87	4.5995		42.7	1120
4/21/97	65	3.25	1500	220	172.3835	0	5.87	4.5995		42.7	1120
8/7/97	10	3.17	1500	232	27.9671	0	7.16	0.8631		48.6	1211
8/7/97	10	3.17	1500	232	27.9671	0	7.16	0.8631		48.6	1211
10/13/97	10	3.23	1600	316	38.0931	0	9.69	1.1681		59.8	1437
10/13/97	10	3.23	1600	316	38.0931	0	9.69	1.1681		59.8	1437
2/6/98	84	3.2	1750	288	291.6295	0	7.06	7.1489		45.8	1214

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/11/98	268	3.23	1400	236	762.4416	0	3.68	11.8889		28	784
7/10/98	35	3.17	1750	314	132.4821	0	6.69	2.8226		65.9	1393
10/7/98	8	3.18	1950	273	26.3276	0	5.18	0.4995		63.1	1346
2/5/99	138	3.09	1800	321	534.0032	0	6.62	11.0127		27.5	1225
5/3/99	110	3.17	1200	216	286.4219	0	4.7	6.2323		35.9	852
7/5/99	20	3.16	1600	240	57.863	0	5.13	1.2368		40.4	1313
10/6/99	7	3.29	1550	199	16.7923	0	3.97	0.335		35.4	982
1/26/00	28	3.14	1600	287	96.8723	0	9.71	3.2774		42.1	1826
4/12/00	118	3.16	1000	218	310.0975	0	6.73	9.5731		29.2	978
7/21/00	32	3.19	1000	264	101.8389	0	8.96	3.4563		39.4	1378
11/9/00	31	3.2	1600	340	127.0575	0	9.3	3.4753		46.5	1375
1/18/01	21	3.2	1000	309	78.2235	0	11.5	2.9112		42.7	1348
4/26/01	323	3.2	1600	247	961.7435	0	6.36	24.7639		28	935
8/2/01	12	3.1	1800	262	37.9002	0	7.7	1.1138		44.1	1392
2/19/02	161	3	2600	245	475.5013	0	11.5	22.3194		36.7	1335
6/3/02	113	3.2	1600	167	227.486	0	6	8.1731		32.5	1082
9/9/02	14	3.1	2400	272	45.9046	0	8.84	1.4919		45.8	1543
12/9/02		3.1	2100	342		0	12.2			50.5	1561

TB-53

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/24/82	40	4.19	220	23	11.0904	0	0.09	0.0433		1.95	79
6/21/82	10	2.92	230	59	7.1123	0	0.29	0.0349		2.46	100
12/9/82	10	4.1	280	17	2.0493	0	0.18	0.0216		3.51	120
2/24/83	20	4.31	270	21	5.063	0	0.13	0.0313		2.92	113
5/26/83	560	4.22	260	15	101.2602	0	0.17	1.1476		2.32	98
12/6/83	600	4.35	265	26	188.0547	0	0.1	0.7232		2.6	99
2/20/84	500	4.37	125	15	90.4109	0	0.1	0.6027		2.07	86
5/23/84	450	1.27	120	14	75.9452	0	0.16	0.8679		1.42	80
9/8/84	100	1.09	160	17	20.4931	0	0.3	0.3616		1.97	8
11/14/84	60	4.24	170	21	15.189	0	0.44	0.3182		2.57	103
3/1/85	140	4.23	230	15	25.315	0	0.29	0.4894		1.49	85
5/15/85	12	4.26	190	19	2.7484	0	0.27	0.039		1.47	91
8/27/85	2	4.44	150	25	0.6027	1	0.27	0.0065		1.05	67
11/26/85	175	4.25	200	39	82.2739	0	0.13	0.2742		1.96	65
3/5/86	125	4.26	180	25	37.6712	0	0.04	0.0602		1.43	77
5/30/86	3	4.23	220	23	0.8317	0	0.12	0.0043		1.51	79
8/8/86	1	4.16	180	19	0.229	0	0.22	0.0026		1.45	68
3/14/88	57	4.47	180	28	19.2394	1	0.28	0.1923		1.29	66
6/1/88	5	4.4	140	27	1.6273	1	0.14	0.0084		1.14	60
8/4/88	1	6.52	600	4	0.0482	97	0.19	0.0022		2.26	108
10/31/88	5	5.53	232	5	0.3013	3	0.31	0.0186		2.17	78
2/14/89		6.06	950	11		12	0.86			1.35	96
4/27/89	13	4.76	225	18	2.8208	3	0.16	0.025		1.35	88
8/3/89	3	4.9	200	11	0.3978	3	0.35	0.0126		1.77	68
11/29/89	14	4.7	220	14	2.3627	3	0.38	0.0641		1.8	79
2/7/90	62	4.89	230	20	14.9479	3	0.23	0.1719		1.19	77
6/5/90	13	4.11	175	18	2.8208	1	0.38	0.0595		1.62	96
8/7/90	9	4.78	230	20	2.1698	2	0.9	0.0976		2.04	87
11/29/90	10	4.5	250	32	3.8575	1	1.11	0.1338		2.04	79
1/23/91	38	4.53	270	25	11.452	1	0.76	0.3481		1.63	91
4/25/91	68	5.8	240	8	6.5578	4	0.28	0.2295		0.99	65
8/19/91	1	7.13	340	13	0.1567	75	0.89	0.0107		1.66	60
12/5/91	33	4.58	240	29	11.5364	0	0.72	0.2864		1.58	92
3/12/92	71	4.97	255	11	9.4147	1	0.53	0.4536		1.9	102
6/30/92	2	4.39	354	30	0.7232	0	1.04	0.025		3.38	282
9/29/92	15	3.95	300	32	5.7863	0	2.05	0.3706		3.09	149
12/28/92	20	4.53	240	30	7.2328	0	1.14	0.2748		2.12	107
10/3/94	43	5.8	290	5	2.5917	11	2.17	1.1248		1.69	84
12/27/94	31	4.67	420	17	6.3528	6	1.89	0.7062		1.96	120

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/28/95	35	4.65	360	16	6.7506	6	0.71	0.2995		1.54	98
6/28/95	41	6.01	580	5	2.4712	12	0.44	0.2174		1.32	68
9/25/95	1	6.65	360	8	0.0964	62	3.34	0.0402		0.8	117
1/1/96		5.22	500	8		8	0.4			3.76	184
3/27/96	45	4.9	240	11	5.9671	6	0.07	0.0379		0.89	71
6/13/96	41	5.97	230	18	8.8964	14	0.21	0.1037		1.19	105
9/26/96	21	5.54	180	4	1.0126	6	2.12	0.5366		1.42	75
9/26/96	21	5.54	180	4	1.0126	6	2.12	0.5366		1.42	75
11/21/96	4	4.78	220	12	0.5786	6	0.97	0.0467		1.66	84
11/21/96	4	4.78	220	12	0.5786	6	0.97	0.0467		1.66	84
1/8/97	10	4.67	220	13	1.5671	5	0.66	0.0795		1.43	84
1/8/97	10	4.67	220	13	1.5671	5	0.66	0.0795		1.43	84
4/21/97	9	4.7	205	10	1.0849	6	0.46	0.0499		1.26	77
4/24/97	9	4.7	205	10	1.0849	6	0.46	0.0499		1.26	77
10/13/97	1	5.21	280	13	0.1567	8	0.36	0.0043		0.89	76
10/13/97	1	5.21	280	13	0.1567	8	0.36	0.0043		0.89	76
2/6/98	11	4.86	190	11	1.4586	7	0.25	0.0331		0.97	74
5/11/98	59	4.99	220	9	6.401	7	0.37	0.2631		1.79	81
7/10/98	1	5.61	260	3	0.0361	9	0.41	0.0049		0.85	61
10/7/98	1	5.36	260	14	0.1687	10	0.81	0.0097		0.72	67
2/5/99	97	4.85	240	12	14.0317	6	0.07	0.0818		0.82	73
5/3/99	10	4.99	245	8	0.9643	7	0.08	0.0096		1.17	92
7/5/99	3	4.72	185	7	0.2531	6	0.09	0.0032		0.57	71
10/6/99	10	6.03	205	5	0.6027	13	0.14	0.0168		0.45	67
1/26/00		5.31	175	6		8	0.26			0.84	68
4/12/00	14	5.15	155	7	1.1813	6	0.13	0.0219		0.76	68
7/21/00	1	5.35	160	8	0.0964	7	0.14	0.0016		0.11	63
11/9/00	6	5.6	220	11	0.7956	11	0.39	0.0282		0.45	55
1/18/01		5.6	170	4		9	0.17			0.72	70
4/26/01	12	5.2	220	9	1.3019	6	0.21	0.0303		0.99	83
8/2/01	1	5.2	210	7	0.0843	7	0.51	0.0061		0.27	58
2/19/02	14	5.9	250	3	0.5063	9	0.25	0.0421		0.6	68
6/3/02	14	5.6	320	4	0.675	7	0.5	0.0843		2.46	124
12/9/02	3	5.6	280	5	0.1808	9	0.14	0.005		0.59	83

TB-75

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/7/82	2	2.99	4500	138	3.3271	0	16.7	0.4026		143	3268
12/9/82	10	3.13	2900	387	46.652	0	2.83	0.3411		96.8	2447
2/24/83	15	3.26	2300	333	60.2136	0	1.29	0.2332		63.3	1480
5/26/83	16	3.29	1300	120	23.1452	0	1.28	0.2468		23.5	705
8/19/83	20	3.34	1200	129	31.1013	0	0.26	0.0626		25.2	690
12/15/83	75	3.83	490	10	9.041	0	0.78	0.7052		10	374
3/7/84	3	3.56	470	43	1.555	0	0.15	0.0054		8.91	276
3/15/84		3.84	550	48		0	0.16			15	451
6/25/84	15	3.64	440	38	6.8712	0	0.45	0.0813		8.84	331
11/8/84	4	3.83	460	37	1.7841	0	0.22	0.0106		12.1	310
3/1/85	50	3.93	560	24	14.4657	0	0.14	0.0843		8.39	279
5/15/85	5	3.69	600	41	2.4712	0	0.2	0.012		9.41	305
11/21/85	20	3.91	400	35	8.4383	0	0.12	0.0289		6.19	207
1/16/86	5	3.79	550	48	2.8931	0	0.1	0.006		9.67	296
5/30/86	1	3.81	500	41	0.4942	0	0.13	0.0015		7.42	220
8/8/86	1	3.58	480	40	0.4821	0	0.2	0.0024		9.04	251
3/14/88	16	4.22	340	46	8.8723	0	0.03	0.0057		6.01	214
6/1/88	4	3.92	420	47	2.2663	0	0.07	0.0033		6.29	183
10/31/88	1	3.93	500	35	0.4219	0	0.07	0.0008		9.16	236
2/14/89	3	4.2	600	33	1.1934	0	0.14	0.005		6.88	231
5/2/89	10	3.98	690	56	6.7506	0	0.31	0.0373		8.54	347
8/3/89	1	3.75	600	55	0.663	0	0.59	0.0071		10	318
11/29/89	1	4.04	500	49	0.5906	0	0.2	0.0024		8.8	264

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/9/90	25	4.15	490	35	10.5479	0	0.36	0.1084		3.95	210
6/5/90	2	3.95	500	41	0.9884	0	0.1	0.0024		5.65	257
8/7/90	2	3.8	600	40	0.9643	0	0.44	0.0106		7.15	290
11/29/90	2	3.98	600	50	1.2054	0	0.22	0.0053		6.97	259
1/23/91		3.95	510	78		0	0.43			5.96	292
4/25/91	24	4	470	54	15.623	0	0.43	0.1244		4.2	207
12/5/91	7	3.83	395	41	3.4597	0	0.22	0.0185		5.11	165
3/18/92	5	3.99	320	66	3.978	0	0.1	0.006		5.13	173
9/29/92	4	3.8	415	29	1.3983	0	0.28	0.0135		6.81	206
12/28/92	15	4.04	600	36	6.5095	0	0.62	0.1121		5.42	224
11/21/96	1	4.04	660	76	0.9161	2	0.47	0.0056		6.79	361
11/21/96	1	4.04	660	76	0.9161	2	0.47	0.0056		6.79	361
1/8/97	2	4.22	510	62	1.4947	4	0.66	0.0159		6.92	359
1/8/97	2	4.22	510	62	1.4947	4	0.66	0.0159		6.92	359
4/21/97	2	4.06	500	58	1.3983	3	0.33	0.0079		6.6	332
4/21/97	2	4.06	500	58	1.3983	3	0.33	0.0079		6.6	332
8/7/97	1	4.05	600	32	0.3857	3	0.21	0.0025		5.14	213
8/7/97	1	4.05	600	32	0.3857	3	0.21	0.0025		5.14	213
10/13/97	1	4.05	370	34	0.4098	3	0.24	0.0028		6.32	212
2/6/98	2	4.13	600	69	1.6635	4	0.39	0.0094		7.24	375
5/11/98	5	3.86	590	59	3.5561	1	0.36	0.0216		5.57	325
2/5/99	8	4.08	400	45	4.3397	2	0.09	0.0086		3.6	231
5/3/99	3	4.1	580	63	2.2783	4	0.1	0.0036		6.63	336
7/5/99	1	3.83	655	74	0.892	1	0.32	0.0038		8.01	401
10/6/99	1	4.04	640	57	0.6871	3	0.05	0.0006		6.76	308
2/19/02	2	4.3	620	31	0.7473	6	0.07	0.0016		4.15	226
6/3/02	4	4.1	800	64	3.086	4	0.13	0.0062		6.51	381

TB-78

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/24/82	2000	4.28	150	16	385.7534	0	0.4	9.6438		1.75	58
6/21/82	2500	3.33	240	30	904.1095	0	2.77	83.4794		2.59	103
9/7/82	400	6.93	280	1	4.8219	6	0.11	0.5304		1.39	96
12/9/82		6.61	240	1		2	0.16			1.42	73
2/24/83	2000	5.69	190	6	144.6575	0	0.07	1.6876		1.15	59
5/26/83	3000	5.11	210	6	216.9863	0	0.65	23.5068		1.66	73
8/19/83	1000	6.21	330	3	36.1643	1	0.09	1.0849		2.53	134
12/15/83	1200	5.25	120	7	101.2602	0	0.17	2.4591		1.78	74
2/20/84	2000	5.14	120	6	144.6575	0	0.55	13.2602		1.92	72
5/23/84	3500	7.49	140	3	126.5753	11	1.04	43.8794		1.45	66
9/7/84	1500	4.42	230	15	271.2328	0	42.2	763.0684		86.3	130
11/14/84	800	5.07	130	12	115.726	1	2.18	21.0235		2.57	101
3/4/85	2500	4.86	200	8	241.0958	0	0.14	4.2191		1.96	78
5/15/85		5.14	210	4		1	0.45			1.58	83
8/27/85		7.32	390	11		6	2.4			2.63	1980
11/26/85		5.13	230	6		3	0.73			2.15	72
3/5/86		4.71	270	18		2	0.59			2.52	102
5/30/86	2000	5.27	250	3	72.3287	3	1.04	25.0739		1.97	91
8/8/86	150	5.13	350	5	9.041	2	1.15	2.0794		3.79	158
3/14/88	7100	5.22	220	6	513.5342	3	0.53	45.3621		1.52	70
6/1/88	1100	4.94	220	6	79.5616	3	1.1	14.5863		2.17	84
8/4/88	1125	5.78	380	3	40.6849	9	0.74	10.0356		2.1	131
10/31/88	500	4.45	500	20	120.5479	1	3.9	23.5068		5.31	201
2/14/89	2250	5.46	500	8	216.9863	4	1.48	40.1424		2.27	111
4/27/89	1597	4.83	370	10	192.515	2	0.92	17.7113		2.75	126
8/3/89	851	4.42	460	20	205.1726	1	2.6	26.6724		4.26	200
11/29/89	1020	4.85	300	8	98.3671	3	1.46	17.952		2.75	139
2/7/90	7670	5.17	230	9	832.1424	3	0.6	55.4761		1.5	79
6/5/90	2895	4.73	237	11	383.8849	2	0.98	34.2006		2.27	113
8/7/90	1711	4.75	400	11	226.8832	2	1.66	34.2387		3.77	174

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/29/90	2100	4.57	390	15	379.726	1	1.82	46.0734		2.9	162
1/23/91	4400	4.52	320	17	901.6986	1	1.5	79.5616		2.5	143
4/25/91	7150	4.85	280	11	948.1095	1	0.66	56.8865		1.66	92
8/19/91	430	4.3	490	23	119.2219	1	3.3	17.1057		6.37	245
12/5/91	5400	5.1	210	11	716.0547	2	0.94	61.1901		2.06	94
3/12/92	6400	5.09	275	13	1002.9589	1	0.83	64.035		2.09	96
6/30/92	2000	4.46	435	15	361.6438	1	1.23	29.6547		1.23	71

TB-83

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/29/92		5.94	135	15		8	0.62			0.24	52
12/28/92		4.86	150	6		2	0.18			0.17	50
10/27/94		5.63	1400	122		22	22.6			17.2	832
12/27/94		4.35	540	11		4	0.66			2.89	144
3/28/95		4.43	590	17		5	0.3			3.72	156
6/28/95		6.19	480	8		21	1.21			5.41	210
9/25/95		6.47	1200	7		45	0.36			3.62	546
3/27/96		4.588	380	22		5	0.1			1.99	201
6/13/96		3.75	2500	205		0	2.58			46.1	1783
9/26/96	92	3.14	3770	380	421.4356	0	73.6	81.6254		65.1	2541
9/26/96	92	3.14	3770	380	421.4356	0	73.6	81.6254		65.1	2541
11/21/96	1	3.31	2400	227	2.7364	0	4.75	0.0572		54.1	1909
11/21/96	1	3.31	3400	227	2.7364	0	4.75	0.0572		54.1	1909
1/8/97	1	3.51	1700	206	2.4832	0	3.38	0.0407		43.8	1543
1/8/97	1	3.51	1700	206	2.4832	0	3.38	0.0407		43.8	1543
4/21/97	1	3.44	1900	213	2.5676	0	4.79	0.0577		47.3	1521
4/24/97	1	3.44	1900	213	2.5676	0	4.79	0.0577		47.3	1521
8/7/97	1	3.43	2150	128	1.543	0	1.06	0.0127		51.4	1705
8/7/97		3.43	2150	128		0	1.06			51.4	1705
10/13/97	1	3.89	1350	105	1.2657	0	16	0.1928		37.9	865
10/13/97		3.89	1350	105		0	16			37.9	865
2/6/98	1	3.78	820	75	0.9041	0	0.31	0.0037		12.9	558
5/11/98	3	3.38	2200	256	9.258	0	1.26	0.0455		37.1	1711
7/10/98	1	3.46	1600	165	1.989	0	4.63	0.0558		40.6	1262
10/7/98	1	3.84	2400	82	0.9884	0	4.4	0.053		64.9	1879
2/5/99	2	4.63	180	11	0.2652	5	0.07	0.0016		0.64	77
5/3/99	1	4.3	460	21	0.2531	5	0.18	0.0021		5.62	223
7/5/99	1	5.53	520	9	0.1084	9	3.24	0.039		6.02	274
10/6/99	1	6.57	280	5	0.0602	56	0.74	0.0089		0.56	65
1/26/00		5.14	120	8		7	0.26			0.52	50
4/12/00	2	4.9	120	6	0.1446	6	0.09	0.0021		0.33	51
7/21/00	1	5.79	800	14	0.1687	16	0.83	0.01		20.1	784
12/18/00	2	4.3	320	47	1.1331	5	0.4	0.0096		2.82	147
3/19/02	2	5	210	4	0.0964	7	0.07	0.0016		0.38	50
4/5/02	2	4.5	480	11	0.2652	7	0.08	0.0019		3.54	150
4/18/02	1	5	110	3	0.0361	6	0.07	0.0008		0.14	37
5/7/02	2	4.8	145	3	0.0723	6	0.07	0.0016		0.12	39
5/21/02	3	5.2	110	3	0.1084	6	0.07	0.0025		0.09	27
6/3/02	3	5.2	240	3	0.1084	7	0.07	0.0025		0.11	37
7/1/02	2	3.4	2200	192	4.629	0	3.93	0.0947		40.4	1991
7/9/02	2	3.4	1800	190	4.5808	0	4.76	0.1147		41.6	1814
7/19/02	2	3.4	2490	178	4.2915	0	3.07	0.074		39.9	1890
8/9/02	1	3.9	2500	113	1.3621	0	0.65	0.0078		44.2	1870
8/26/02	1	4.7	1300	38	0.458	8	0.07	0.0008		21.5	1028
9/9/02	1	4.8	2400	20	0.241	9	0.31	0.0037		43.3	1836
9/21/02	1	6.2	2400	7	0.0843	20	0.07	0.0008		37.1	2039
10/9/02	1	4.8	1500	47	0.5665	9	2.51	0.0302		26.9	1257

TB-99

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
7/10/89	75	3.56	4000	679	613.8904	0	2.94	2.658		87.6	3613
11/29/89	9	3.16	1200	288	31.246	0	10.6	1.15		14.2	675
2/9/90	29	3.46	700	45	15.7315	0	3.38	1.1816		4.67	315
6/5/90	8	3.01	1100	194	18.709	0	6.19	0.5969		10.5	685
8/7/90	5	3.43	1300	98	5.9068	0	5.98	0.3604		10.3	670
11/29/90	7	3.18	1400	191	16.1172	0	9.98	0.8421		11.5	568
1/23/91		3.5	680	61		0	7.77			6.87	348
4/25/91	129	3.39	620	67	104.1895	0	2.9	4.5096		4.07	233
8/19/91	1	2.61	1900	290	3.4958	0	18.7	0.2254		26.9	1278
12/5/91	8	3.18	850	166	16.0087	0	7.42	0.7155		7.11	324
3/18/92	21	3.29	700	187	47.3391	0	7.39	1.8707		7.22	393
6/30/92	1	2.71	2600	478	5.7621	0	10.9	0.1313		24.3	1438
9/29/92	5	3.09	1150	123	7.4136	0	8.01	0.4827		11.4	546
9/26/96	4	3.71	550	43	2.0734	0	1.47	0.0708		4.9	265
9/26/96	4	3.71	550	43	2.0734	0	1.47	0.0708		4.9	265
11/21/96	4	3.71	1200	26	1.2536	0	1.4	0.0675		4.64	287
11/21/96	4	3.71	1200	26	1.2536	0	1.4	0.0675		4.64	287
1/8/97	2	3.7	450	32	0.7715	0	2.36	0.0568		4.96	265
1/8/97	2	3.7	450	32	0.7715	0	2.36	0.0568		4.96	265
4/21/97	5	3.57	590	33	1.989	0	2.22	0.1338		6.24	331
4/21/97	5	3.57	590	33	1.989	0	2.22	0.1338		6.24	331
8/7/97	1	3.02	1600	170	2.0493	0	12.2	0.147		19	1012
8/7/97	1	3.02	1600	170	2.0493	0	12.2	0.147		19	1012
10/13/97	1	3.14	1550	174	2.0975	0	7.21	0.0869		16.9	923
10/13/97	1	3.14	1550	174	2.0975	0	7.21	0.0869		16.9	923
2/6/98	4	3.67	400	34	1.6394	0	1.47	0.0708		13.8	210
5/11/98	47	3.94	340	26	14.7309	0	1	0.5665		2.13	145
7/10/98	3	3.1	1150	213	7.703	0	9.1	0.329		14.8	775
10/7/98	1	3.03	1800	252	3.0378	0	9.2	0.1109		16.7	960
2/5/99	26	3.82	300	27	8.4624	0	0.37	0.1159		2.01	129
5/3/99	7	3.62	560	38	3.2065	0	0.68	0.0573		3.9	245
7/5/99	1	3.2	1050	146	1.76	0	7.77	0.0936		12.1	604
10/6/99	3	3.4	680	69	2.4953	0	1.68	0.0607		7.05	296
1/26/00		3.61	540	31		0	1.37			7.42	379
4/12/00	14	3.89	240	15	2.5315	0	0.38	0.0641		2.26	140
7/21/00	2	3.18	1000	118	2.8449	0	9.4	0.2266		13.9	807
11/9/00	3	3.4	1000	90	3.2547	0	3.28	0.1186		10.2	479
2/19/02	5	3.6	820	21	1.2657	0	0.78	0.047		4.44	286
6/3/02	6	3.7	780	17	1.2295	0	0.97	0.0701		3.15	222
12/9/02		3.5	730	26		0	1.46			6.8	300

178130 55 (Thompson Bros)

TB-1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/15/82	1000	6.49	400	107	1289.863	0	3.79	45.6876		3.78	164
6/21/82	1000	2.78	500	94	1133.1506	0	1.92	23.1452		6.68	250
9/7/82	150	3.18	850	164	296.5479	0	3.4	6.1479		12.8	361
12/7/82	200	3.38	600	164	395.3972	0	2.46	5.9309		7.91	284
12/9/82		7.05	1400	1		152	0.61			0.3	477
2/24/83	300	3.51	500	106	383.3424	0	1.6	5.7863		5.72	227
5/26/83	1500	3.3	700	170	3073.9726	0	4.79	86.6136		7.1	305
5/26/83		4.51	1700	29		1	43			5.8	9
8/18/83		3.23	900	330		0	2.82			16.3	530
8/19/83		7.11	2200	11		83	7.48			1.18	930
12/6/83	1200	3.13	1050	367	5308.9315	0	13.4	193.841		8.27	370
3/15/84		3.34	500	154		0	5.97			11.4	402

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/20/84		6.46	2000	80		86	38.3			4.58	1623
5/25/84	400	3.2	450	2	9.6438	0	5.6	27.0027		8.89	313
9/7/84	75	3.2	725	346	312.8219	0	4.71	4.2583		19.1	540
11/8/84	60	3.29	600	210	151.8904	0	5.4	3.9057		15.8	445
12/5/84		3.72	1900	320		3	87.4			14.5	1882
2/28/85	600	3.21	670	113	817.315	0	5.88	42.5293		8.82	302
3/11/85		4.72	200	30		3	0.36			2.39	90
5/20/85	210	3.16	800	247	625.2821	0	4.51	11.417		14.2	434
6/7/85		3.11	1250	163		0	26.3			39.3	1284
8/23/85		2.8	1100	2318		0	6.74			18.2	440
11/15/85		4.01	440	66		0	2.55			11.9	276
11/21/85	550	3.16	700	282	1869.6986	0	6.98	46.2783		11.5	370
1/16/86	10	3.15	1100	374	45.0849	0	6.68	0.8052		22.4	690
1/16/86		5.33	207	26		4	0.21			1.89	99
5/30/86	750	3.17	800	255	2305.4794	0	6.99	63.1972		13.8	419
5/30/86		5.78	310	18		4	0.51			4.15	154
8/8/86	150	3.18	1000	274	495.452	0	2.38	4.3035		18.6	665
8/8/86		3.34	1500	66		0	16.5			43.4	1019
11/10/86	1750	3.23	460	143	3016.7123	0	7.78	164.126		6.73	234
3/4/87	600	3.08	850	3	21.6986	0	14.9	107.7698		12.1	451
5/12/87	340	3.09	930	275	1127.1232	0	6.43	26.3541		15.4	402
8/11/87	60	3.33	1400	489	353.6876	0	12.4	8.9687		30.4	710
11/2/87	34	2.94	900	278	113.9419	0	8.17	3.3485		18.9	528
3/14/88		5.5	140	11		4	0.1			0.65	57
3/14/88	880	3.35	680	180	1909.4794	0	21.8	231.2591		13.5	371
6/1/88	260	3.07	1230	364	1140.8657	0	9.14	28.647		19.2	603
6/1/88		5.67	200	4		4	0.12			1.75	89
7/29/88	25	2.97	1690	538	162.1369	0	13.9	4.189		25.9	829
8/4/88		3.47	1400	84		0	19.4			37.7	795
10/31/88		5.57	340	9		4	0.36			4.12	131
10/31/88	55	3.01	1460	409	271.1726	0	18.3	12.1331		28.2	693
2/6/89	175	3.31	1100	274	578.0273	0	11.3	23.8383		13.7	516
2/14/89		5.19	250	16		4	0.16			0.66	76
4/27/89		5.27	250	11		4	0.27			1.21	123
4/27/89	300	3.32	1300	319	1153.6438	0	7.51	27.1594		25.8	750
8/3/89	177	3.16	1700	381	812.9391	0	9.79	20.8889		34	881
8/3/89		3.35	1450	211		0	25.1			40	885
11/2/89	51	3.09	1400	556	341.8257	12	19.7	12.1114		29.6	773
11/29/89		5.32	220	5		3	0.26			1.41	91
1/23/90		3.19	1000	312		0	14.9			23.1	615
2/9/90		5.35	10	32		5	0.06			0.22	43
2/9/90	975	3.53	950	159	1868.7945	0	5.85	68.7575		14.7	515
6/5/90		4.5	120	7		2	0.08			0.48	61
6/5/90	608	3.16	950	178	1304.618	0	5.91	43.3162		17.2	654
8/7/90		4.77	370	10		2	0.44			5.15	181
8/7/90	372	3.72	1200	241	1080.7364	0	9.81	43.9918		25.2	611
11/29/90		6.14	240	3		4	0.07			1.1	79
11/29/90	462	3.13	1500	308	1715.349	0	11.8	65.7179		26.3	651
4/5/91	1832	3.12	600	253	5587.349	0	16.7	368.8092		12.7	414
4/25/91		5.89	220	3		3	0.25			1.1	86
8/19/91	26	2.77	1500	458	143.5484	0	23.6	7.3968		51.7	1080
8/19/91		3.33	1100	87		0	23.3			45	935
12/5/91	1108	2.83	1150	428	5716.6728	0	36.2	483.5129		16	493
12/5/91		5.3	250	31		3	0.2			1.91	104
3/12/92	900	2.93	800	262	2842.5205	0	19.2	208.3068		13.1	419
3/18/92		5.1	160	23		2	0.38			0.51	74
3/28/92		5.33	350	17		9	0.48			0.29	67
6/30/92		3.32	1600	190		0	31.3			34.2	1022
6/30/92	6	2.98	2350	546	39.4915	0	22.9	1.6563		47.6	1419
9/29/92	250	2.82	1450	361	1087.9452	0	37.6	113.315		25.7	967
9/29/92		4.74	210	41		1	0.4			1.71	100
12/28/92	300	3.14	1000	337	1218.7397	0	24.5	88.6027		18.9	558
12/28/92		5.02	260	24		3	0.29			0.25	71

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
1/1/94	610	3.13	1200	235	1728.0547	0	17.4	127.9495		27.7	770
10/3/94		5.07	380	7		7	0.39			1.88	85
12/27/94	874	3.1	920	153	1611.9912	0	10.4	109.5732		17.6	492
12/27/94		5.56	380	5		8	0.08			0.71	76
3/28/95	314	3.21	1200	151	571.566	0	8.86	33.5369		17	489
6/28/95	140	3.08	1100	217	366.2246	0	9.74	16.4379		18.6	475
6/28/95		3.79	1000	36		0	5.47			22.8	540
9/25/95	45	2.97	1500	326	176.8438	0	22.9	12.4224		37.8	953
1/1/96		3.29	1100	139		0	11.5			15	572
3/27/96	370	3.34	900	194	865.2931	0	9.02	40.2316		18.1	474
6/13/96	311	3.21	1100	212	794.7967	0	9.72	36.4406		29.6	849
9/26/96		2.66	1300	462		0	168			32.4	1134
9/26/96	67	3.22	1200	246	198.6871	0	14.2	11.4689		32.4	785
11/21/96	50	3.24	1200	244	147.0684	0	16.8	10.126		34.9	912
1/8/97	80	3.16	1150	326	314.389	0	26.7	25.749		33.6	907
4/21/97	87	3.23	1400	257	269.5331	0	18.3	19.1924		38.7	870
8/7/97	7	2.96	1600	266	22.446	0	23.7	1.9998		44.8	1074
10/13/97	7	2.97	1600	372	31.3906	0	36.6	3.0884		43.3	1143
2/6/98	54	3.06	1350	399	259.7326	0	31	20.1797		31.6	829
5/11/98	172	3.11	1200	271	561.898	0	12.5	25.9178		34.3	672
7/10/98	14	2.98	1600	502	84.721	0	12.1	2.042		59.2	1083
10/7/98	7	2.9	1800	434	36.6224	0	14	1.1813		38.3	969

17820149 (Graham)

GB-1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/26/96	251	3.46	740	123	372.1676		3.74	11.3163		11.9	415
11/21/96	86	3.51	730	100	103.6712		3.45	3.5766		8.23	457
1/8/97	133	3.4	700	121	193.9978		7.73	12.3934		11.9	421
4/21/97	187	3.4	700	88	198.3736		6.07	13.6832		13.8	439
8/7/97	40	2.98	1550	178	85.8301		13.6	6.5578		23.8	874
10/13/97	13	3.04	1350	249	39.0213		17.7	2.7738		25.3	862
2/6/98	445	3.41	640	136	729.5561		4.76	25.5344		7.98	362
5/11/98	343	3.35	675	141	583.006		3.1	12.8178		9.26	299
7/10/98	129	2.92	1200	266	413.6482		9.77	15.193		29.8	807
10/7/98	36	2.99	1800	353	153.1923		17.7	7.6813		19.6	890

GB-3

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/7/84		4.3	670	78.5		6	0.15			7.1	255.6
8/2/84		4.25	300	21		4	0.02			1.5	63.5
11/8/84	1	5.1	370	12.5	0.1506	7.5	0.23	0.0027		6.99	132.8
2/27/85	30	4.065	260	24.5	8.8602	10	0.02	0.0072		1.15	45.4
5/20/85	1	4.25	360	26	0.3134	3.5	4.48	0.054		1.71	126.4
1/25/86	25	4.36	320	28.5	8.589	3.5	0.07	0.021		1.43	66.3
10/21/86	1	4.45	355	20.5	0.2471	6	0.22	0.0026		2.11	116

GB-4

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/8/83	2.5	4.1	255	44.5	1.341	2.5	0.41	0.0123		1.65	79.1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
8/26/92	0.5	4.05	380	63.5	0.3827	4	0.22	0.0013		4.02	141.3
12/4/92	1.5	3.75	325	57.5	1.0397	0	0.24	0.0043		2.66	120.4
2/12/93	1	3.65	260	35	0.4219	0	0.12	0.0014		2.19	99.3
11/2/93	0.5	4	300	42	0.2531	2	0.13	0.0007		3.49	89.7
3/31/94	539	3.75	240	32.5	211.1698	0	0.06	0.3898		1.59	89.7
6/17/94	0.5	4	305	44	0.2652	2.5	0.02	0.0001		2.37	97.3
8/24/94	0.5	3.75	310	55	0.3315	0	0.28	0.0016		2.81	108.9
12/7/94	7.5	3.6	240	45	4.0684	0	0.15	0.0135		2.94	67.2
3/31/95	3.75	4.05	240	46.5	2.102	1.5	0.02	0.0009		1.61	87.2
6/21/95	1.5	3.45	260	32.5	0.5876	0	0.28	0.005		1.62	87.9

GB-5

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/7/84	45	3.4	580	82.5	44.7534	0	5.22	2.8316		5.11	129.8
8/2/84	75	3.5	490	64	57.863	0	5.05	4.5657		4.75	141.9
11/8/84	20	3.15	750	102	24.5917	0	12.2	2.9413		6.68	250.3
2/27/85	125	4.2	420	49	73.8356	6	4.39	6.615		4.05	123.9
5/20/85	32	4.15	690	92.5	35.6821	0	2.98	1.1495		5.99	217.6
9/23/85	15	3.1	1400	125	22.6027	0	8.42	1.5225		6.62	271
10/28/85	20	2.65	1400	195	47.0136	0	13.2	3.1824		10.78	312.1
1/25/86	100	3.7	460	63.5	76.5479	0	5.37	6.4734		3.52	151.1
10/21/86	56	3.2	630	65	43.8794	0	5.05	3.409		4.2	177.7
3/25/87		3.45	525	50		0	3.47			4.8	167.6
6/30/87	112	3.2	685	76.5	103.2854	0	3.79	5.117		4.69	185.4
9/27/87	38	3.25	685	80	36.6465	0	2.27	1.0398		5.5	224.7
12/31/87	40	3.45	600	56.5	27.2438	0	6.42	3.0956		4.45	180.9
3/30/88	150	3.65	610	67	121.1506	0	2.94	5.3161		6.19	254.3
6/30/88	20	3.35	840	89	21.4575	0	1.71	0.4122		7.37	316
9/16/88	10	3.15	1300	106.5	12.8383	0	3.27	0.3941		8.21	288.3
12/19/88	20	3.55	1100	99	23.8684	0	2.93	0.7064		6.36	273.2
3/31/89	100	3.35	420	55.5	66.9041	0	2.53	3.0498		3.84	118.5
6/28/89	449	3.65	710	34	184.0284	0	2.92	15.8048		6.18	248.9
9/7/89	25	3.35	760	65	19.589	0	2.03	0.6117		7.91	250.3
11/14/89	25	3.45	665	55	16.5753	0	2.49	0.7504		6.8	248.9
2/12/90	448	3.75	425	42.5	229.5232	0	2.21	11.9352		3.89	145.7
6/30/90	125	3.4	695	59	88.9041	0	1.03	1.552		5.63	210.4
9/30/90	673	6.9	1750	0	0	19.5	1.19	9.6543		1.85	740.4
12/17/90	120	3.65	495	46	66.5424	0	2.48	3.5875		4.88	158.9
2/25/91	180	3.85	445	53	115.0027	0	3.17	6.8784		4.82	160.8
4/29/91	135	3.5	635	65.5	106.5945	0	2.46	4.0033		5.43	215.3
7/3/91	30	3.4	740	62	22.4219	0	1.72	0.622		6.49	224.5
11/19/91	15	3.35	635	70.5	12.7479	0	2.04	0.3688		6.32	190.7
2/6/92	45	3.65	510	53.5	29.0219	0	2.28	1.2368		4.83	158.9
5/1/92	75	3.65	450	41.5	37.5205	0	1.01	0.9131		4.42	149.1
8/26/92	808	3.25	3600	205	1996.7561	0	46.7	454.8707		43.7	1062.1
12/4/92	84	3.3	530	59	59.7435	0	3.13	3.1694		4.81	159.8
2/12/93	90	3.15	500	60	65.0958	0	2.75	2.9835		4.99	145.2
5/8/93	100	3.4	485	32	38.5753	0	1.37	1.6515		3.68	128.2
7/23/93	7.5	3.35	530	58	5.2438	0	1.8	0.1627		5.95	179.4
11/2/93	30	3.35	610	50.5	18.263	0	2.13	0.7703		4.95	160.8
3/1/94	15	4.05	135	27	4.8821	1.5	1.24	0.2242		2.59	55.2
6/17/94	135	3.35	2000	132	214.8164	0	29.06	47.2921		24.14	755.7
8/24/94	135	3.55	1600	60	97.6438	0	1.33	2.1644		5.91	342.9
12/7/94	225	3.65	730	15	40.6849	0	4.14	11.229		25.28	309
3/31/95	80	3.55	450	36.5	35.2	0	0.86	0.8293		3.65	150.3
6/21/95	30	2.9	520	60	21.6986	0	0.99	0.358		3.51	138.2
8/15/95	7.5	3.15	630	70	6.3287	0	2	0.1808		4.98	158.4
10/1/95	15	3.3	640	64	11.5726	0	1.43	0.2585		5.83	156.7

GB-8

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/7/84	3	4.2	390	76.5	2.7665	5	0.11	0.0039		3.25	164.9
6/30/84	1	3.9	340	55	0.663	0	0.2	0.0024		3.32	126.1
8/20/84	4	3.85	370	70.5	3.3994	0	0.23	0.011		4.48	152
11/8/84	1	4	420	77	0.9282	1	0.8	0.0096		6.9	185.9
2/27/85	3	4.35	340	78.5	2.8389	10.5	0.11	0.0039		3.2	128.4
5/20/85	1	3.85	380	74	0.892	0	0.3	0.0036		3.93	173.5
1/25/86	3	4.15	340	69.5	2.5134	2	0.09	0.0032		2.56	117.4
10/21/86	1	3.9	420	77.5	0.9342	0	0.21	0.0025		4.23	180.7
3/25/87	2	4.15	335	56	1.3501	3.5	0.18	0.0043		2.97	127.6
12/31/87	1	4.1	350	70.5	0.8498	3	0.7	0.0084		3.47	110.5
3/30/88	1	4.2	265	50.5	0.6087	5	0.1	0.0012		2.27	95.4
3/31/89	2	3.75	210	36	0.8679	0	0.07	0.0016		1.74	65.9
6/28/89	5	3.9	240	37	2.2301	0	0.14	0.0084		1.94	75.6
2/12/90	1	4.25	235	37.5	0.452	4.5	0.24	0.0028		1.98	84
6/30/90	1	4.05	355	49	0.5906	3	0.27	0.0032		3.01	113.7
9/30/90	5	4.05	300	47	2.8328	3.5	0.27	0.0162		2.95	114.7
12/17/90	2.5	4.1	320	53	1.5972	4	0.13	0.0039		3	122.8
2/25/91	3.75	4.36	280	44.5	2.0116	8	0.04	0.0018		2.66	104.6
4/29/91	3.8	4.15	315	53.5	2.4507	3.5	0.26	0.0119		2.51	119.3
7/3/91	1.5	3.95	405	55.5	1.0035	1.5	0.15	0.0027		4.81	147.1
11/19/91	1	4.25	305	38	0.458	5.5	0.55	0.0066		3.48	100.4
2/6/92	0.8	4.35	325	58	0.5593	9.5	0.06	0.0005		2.66	116
5/1/92	2.1	4.15	260	43.5	1.1012	4	0.02	0.0005		2.17	100.7
8/26/92	0.5	4.05	380	63.5	0.3827	4	0.22	0.0013		4.02	141.3
12/4/92	1.5	3.75	325	57.5	1.0397	0	0.24	0.0043		2.66	120.4
2/12/93	1	3.65	260	35	0.4219	0	0.12	0.0014		2.19	99.3
5/8/93	2.5	4.1	255	44.5	1.341	2.5	0.41	0.0123		1.65	79.1
11/2/93	0.5	4	300	42	0.2531	2	0.13	0.0007		3.49	89.7
3/31/94		3.75	240	32.5		0	0.06			1.59	89.7
6/17/94	0.5	4	305	44	0.2652	2.5	0.02	0.0001		2.37	97.3
8/24/94	0.5	3.75	310	55	0.3315	0	0.28	0.0016		2.81	108.9
12/7/94	7.5	3.6	240	45	4.0684	0	0.15	0.0135		2.94	67.2
3/31/95	3.75	4.05	240	46.5	2.102	1.5	0.02	0.0009		1.61	87.2
6/21/95	1.5	3.45	260	32.5	0.5876	0	0.28	0.005		1.62	87.9

GB-9

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/7/84		4.7	810	56		11	1.38			2.04	231.8
8/20/84		3.75	410	25.5		0	2.33			3.53	127
11/8/84		4.9	470	11.5		7.5	0.13			2.3	169.4
2/27/85		3.3	1400	214		0	51.4			2.37	271
5/20/85		4.1	740	31.5		1.5	1.1			1.74	327.8
9/23/85		4.9	620	32.5		17.5	1.52			4.49	258.1
1/25/86		5.1	520	19.5		11	0.28			1.31	193.3
10/21/86		3.8	620	67.5		0	2.05			7.7	263.7
6/30/87		6	350	2.5		14.5	0.16			0.82	90.7

1784 160 6 (Avery C0 al C0)

AT-3

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
10/17/94		6.5		0		76	0.483		0.5	0.414	46

AT-7

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
10/18/94		4.4		56		7.2	17.4		7.91	3.41	88

AT-12

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/3/94		5.3		22		9.8	0.3		0.5	0.284	68

AT-13

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/6/88	1	6.3	730	7	0.0843	10	0.01	0.0001		0.39	314
12/9/88	1	6.7	600	2	0.0241	14	0.01	0.0001		0.37	329
1/25/89	1	7	540	6	0.0723	28	0.06	0.0007		0.21	321
7/18/90	3	7.2	835	22.5	0.8136	40	0.23	0.0083		0.51	304.9
10/17/90	2.3	4.7	940	69.5	1.9269	11.5	0.67	0.0185		7.53	320.5
1/25/91	2.5	4.8	780	30	0.9041	9	0.15	0.0045		3.35	232.8
4/17/91	7	5.05	725	11.5	0.9704	10	0.32	0.027		2	192.3
7/31/91	1.5	4.5	890	76.5	1.3832	10.5	0.2	0.0036		5.96	377.9
10/24/91	1.3	4.45	900	95	1.4887	9	0.41	0.0064		7.18	386.4
3/30/92	1.5	4.5	740	57.5	1.0397	10	0.13	0.0023		4.08	197.8
5/19/92	0.5	4.7	740	52.5	0.3164	11	0.09	0.0005		3.92	209.2
4/29/93		4.7		6.8		7	0.3		0.781	0.926	92
5/6/93	1	4.6	419	30	0.3616	4	0.09	0.001		2.13	200
5/3/94		4.7		44		9.4	0.3		3.65	1.96	152
10/18/94		4.4		82		7.6	0.3		10.6	4.97	200
6/6/95		4.4		60		7.4	0.3		7.04	2.91	174
4/26/96		4.4		30		6.6	0.3		5.41	2.19	122
5/8/98	4	7.1	500	6	0.2893	18	0.5	0.0241		0.21	252

AT-14

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
4/12/91		2.4		3520		0	300		297	97.2	1518
5/4/92		2.7		1520		0	49.2		187	55	1464
6/1/93		2.8		946		0	20.8		126	72.8	1716
2/15/96		3		860		0	61.9		106	413	1300

AT-15

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
4/11/91		2.3		5140		0	300		390	110	3318
5/4/92		2.4		3560		0	300		319	82.6	2415
11/3/92		2.5		1800		0	180		158	46.8	804
11/4/93		2.4		1772		0	158		163	49	1200
4/4/95		2.4		3386		0	300		329	45	2964
2/16/96		2.5		1614		0	132		164	132	1875
2/3/98	10	2.7		1066	128.5041	0	59.6	7.1846	128	34.9	1724

AT-16

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
4/11/91		2.4		3380		0	300		307	58.4	2961
9/22/93		2.3		3840		0	300		398	68.9	1844
11/5/93		2.4		3462		0	300		371	56.9	1770
4/3/95		3.3		388		0	85		10.3	45	1155
2/15/96		2.4		3096		0	295		326	38.5	2979

AT-17

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/6/88	30	3.4	780	82	29.6547	0	1.36	0.4918		5.59	429
12/9/88	40	3.4	1200	82	39.5397	0	3.53	1.7021		15.3	740
1/25/89	150	3.5	690	88	159.1232	0	2.44	4.412		8.86	419
5/8/89	75	3.9	400	58	52.4383	0	0.71	0.6419		6.3	314
8/18/89	30	3.1	1820	370	133.8082	0	14.9	5.3884		48.1	1100
5/4/90		3.6		96		0	29.5		2.22	18	444
7/3/90		3.6		44		0	3.14		2.17	10.2	433
7/18/90	561	3.65	705	56	378.7134	0	2	13.5254		10.46	268.4
10/17/90	449	8.15	1400	5	27.063	27	0.81	4.3842		1.02	580.1
1/25/91	410	3.9	530	45	222.4109	0	2.73	13.4929		5.47	167.4
3/6/91		6.4		0		16	2.95		1.88	2.37	492
4/17/91	337	3.95	1550	58.5	237.6542	2	8.22	33.3934		6.83	612.7
7/31/91	127	3.45	680	65	99.5123	0	3.4	5.2052		6.52	203.2
10/24/91	125	3.55	720	55	82.8767	0	4.1	6.178		6.8	218.1
3/3/92	205	4	260	25.5	63.0164	2	1.12	2.7677		2.17	72.4
5/19/92	273	6.15	2800	5	16.4547	15.5	1.56	5.1338		4.72	1242
3/31/93	300	3.8	582	84	303.7808	0	3.23	11.681		11.4	401
5/28/93	70	3.3	2120	500	421.9178	0	13.8	11.6449		66	359
8/10/93	32	3	2120	474	182.8471	0	20.5	7.9079		48.8	886
12/2/94		5.1		6.4		8.8	1.4		0.837	1.77	165
1/20/95		3.9		22		0	1.24		1.3	3.02	82
10/24/96	150	3.8		26	47.0136	0	1.35	2.441	1.69	2.92	75.7

AT-18

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/6/88	60	2.9	2010	738	533.7863	0	51.8	37.4663		29.1	919
12/9/88	60	3.2	1575	262	189.5013	0	14.2	10.2706		30.8	886
1/25/89	175	3.2	1270	388	818.5205	0	17.4	36.7068		17	762
5/8/89	110	3.3	925	230	304.9863	0	10.7	14.1884		16.5	700
8/18/89	65	3.1	1920	422	330.663	0	15.7	12.3019		58	1230
5/4/90		3.3		202		0	20.8		16.1	31.7	780
7/3/90		3.2		228		0	13.1		21.5	30.2	774
7/18/90	898	3.25	2200	311.5	3372.0515	0	22.7	245.7321		25.1	760.8
10/11/90	748	3.15	1900	335	3020.6904	0	34.4	310.1843		32.2	712.1
1/25/91	800	3.25	2400	371	3577.863	0	33.4	322.1041		37.2	869.7
4/11/91		3.2		234		0	22.7		20.7	33.5	876
4/14/91	673	3.35	1800	265	2149.9123	0	26	210.9347		28.4	728.4
7/31/91	224	3	2950	478.5	1292.081	0	37.7	101.8003		49.8	1131.7
10/24/91	198	3.05	3200	547	1305.6065	0	55.5	132.4701		55.2	1088.9
3/3/92	337	3.15	2000	400	1624.9863	0	40	162.4986		22.22	653.7
5/19/92	310	3.4	2750	187.5	700.6849	0	8.15	30.4564		24.9	1226
3/31/93	1010	3.5	1010	196	2386.3671	0	5.46	66.4773		21.2	663
5/28/93	122	2.9	2120	476	700.046	0	16.7	24.5604		59.4	582
8/10/93	60	2.6	3410	1630	1178.9589	0	172.9	125.0564		53.8	1920
8/3/94		2.9		480		0	30.7		31.5	46.5	962
1/20/95		3.1		326		0	30.6		33.3	18.7	537
9/11/95		3		380		0	25.8		22.7	50	1058

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
4/17/97	100	3.3		284	342.3561	0	13.4	16.1534	21.6	29.6	990
4/13/98	50	3.3		260	156.7123	0	14.8	8.9205	21.6	19	598.6
8/31/98	30	3		292	105.6	0	12.1	4.3758	19.5	37.8	1148.7

AT-19

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/6/88	60	4.2	490	60	43.3972	4	0.24	0.1735		8.3	288
12/9/88	80	5	250	14	13.5013	10	0.23	0.2218		3.13	81
1/25/89	225	4.6	190	42	113.9178	5	0.08	0.2169		1.85	86
5/8/89	500	4.5	175	44	265.2054	8	0.23	1.3863		2.1	78
8/18/89	45	3.7	650	7.2	3.9057	0	0.47	0.2549		13.3	376
1/24/90	2500	4.2	400	24.5	738.3561	4.5	1.18	35.5616		4	112.7
7/18/90	1560	4.4	275	17	319.6931	7	1.52	28.5843		3.17	91.6
10/11/90	2244	4.55	260	19	513.9682	7	0.94	25.4279		3.09	76.1
4/14/91	2244	4.4	305	21	568.0701	7	0.58	15.6895		3.1	94.7
7/31/91	448	4.05	455	24.5	132.3134	3	0.92	4.9685		6.11	150.3
10/24/91	374	4.4	400	24	108.2038	8	0.71	3.201		5.47	122.9
3/3/92	598	4.7	180	13	93.7139	9	0.28	2.0184		1.94	55.1
5/19/92	673	4.3	350	21.5	174.4268	5.5	0.36	2.9206		4.32	117.7
3/31/93		4.9	137	4		8	0.72			1.41	51
5/28/93	428	4	516	54	278.6104	0	1.53	7.8939		9.26	258
8/10/93	125	3.9	432	66	99.452	0	2	3.0136		6.54	119

AT-21

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
7/18/90	665	3.65	980	94	753.5452	0	2.44	19.5601		18.54	500.1
10/17/90	524	3.55	1200	110	694.8383	0	5.52	34.8682		17.2	545.3
1/25/91	536	3.4	2200	290.5	1877.0279	0	24.2	156.3651		36.3	884
3/3/91	263	3.55	760	80	253.6328	0	5.15	16.3276		13.7	318.7
4/17/91	449	3.45	1250	125	676.5753	0	11.86	64.1934		19.72	567.8
7/31/91	205	3.1	2500	301.5	745.0767	0	27.9	68.9473		49.4	872.8
10/24/91	182	3.2	2450	303	664.7736	0	30.3	66.4773		48.2	927.7
5/19/92	295	3.55	2800	133	472.9698	0	5.21	18.5276		21.76	1131.7
3/31/93	375	3.8	646	94	424.9315	0	3.32	15.0082		13.9	429
5/28/93	96	3.3	2110	484	560.1139	0	14.2	16.433		62.5	1003
8/10/93	58	2.8	2450	708	495.018	0	35.8	25.0305		48.4	1162

AT-104

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
7/18/90	10	2.45	7850	3434.5	414.0219	0	400.1	48.2312		72.1	3994
10/17/90	6	2.3	8000	4430	320.4164	0	642.6	46.4784		141	4704
1/25/91	8	2.5	5600	2602.5	250.9808	0	321.1	30.9663		90.5	3317
4/17/91	3	2.3	9500	5250	189.863	0	823.8	29.7922		122.3	4277.7
7/31/91	2	2.2	9950	5230	126.0931	0	730	17.6		132.7	4704.2
10/24/91	2	2.25	18500	4855	117.052	0	706.4	17.031		105.1	4628.5
3/3/92	3	2.25	9100	5730	207.2219	0	820.6	29.6764		96.1	5413.2
5/19/92	1	2.15	23500	8057	97.1254	0	1508	18.1786		124.9	7931.5
3/31/93	20	2.4	3860	1994	480.7452	0	214.9	51.8115		39.9	1664
5/28/93	8	2.7	2940	968	93.3523	0	16.5	1.5912		64.4	1050

AT-SEEP1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
7/3/90		2.3		3640		0	300		300	79.8	1770
9/17/90		2.4		2260		0	126		244	68.7	3091

AT-SEEP2

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
7/3/90		2.4		2060		0	130		215	65.5	1908
9/17/90		2.2		5060		0	300		416	111	4284

AT-SEEP3

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
7/3/90		2.6		1522		0	59.3		211	43.2	1872

17870129 (Sky Haven)

SH-1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
1/28/86	4.5	4.13	410	15	0.8136	0	0.67	0.0363		0.43	183
2/26/86	112	4.47	280	12	16.2016	0	0.09	0.1215		0.29	155
5/2/86		4.62	360	9		1	0.11			0.3	175
6/5/86	80	4.3	460	15	14.4657	0	0.31	0.2989		0.51	181
9/30/86	7.2	3.49	600	37	3.2113	0	0.01	0.0008	2.7	1	236
10/20/86	7.2	3.99	500	25	2.1698	0	0.5	0.0433	1.5	0.82	249
11/3/86	19.7	3.97	600	30	7.1243	0	0.8	0.1899	2.1	1	250
11/19/86	34.5	4.52	495	24	9.9813	1	0.5	0.2079	2.3	0.83	205
12/7/86	65.7	4.52	410	12	9.504	1	0.2	0.1584	1.5	0.31	157
12/22/86	20.7	4.52	410	13	3.2439	1	0.2	0.0499	0.9	0.27	185
1/7/87	37.6	4.53	380	11	4.9858	1	0.4	0.1813	0.7	0.29	201
1/21/87	20.3	4.61	390	3	0.7341	1	0.4	0.0978	0.7	0.37	190
2/6/87	15.9	4.65	380	7	1.3416	1.5	0.3	0.0575	0.1	0.41	197
2/17/87	12.5	4.26	360	8	1.2054	0	0.2	0.0301	0.6	0.39	200
5/1/87	34.5	4.9	360	8	3.3271	0	0.1	0.0415	0.6	0.3	180
5/15/87	34.5	5.02	360	35	14.5561	0	0.1	0.0415	0.6	0.31	170
9/19/88	10	4.1	600	46	5.5452	0	0.78	0.094		1.03	401
10/21/88	1	6.8	550	4	0.0482	0	0.34	0.004		0.41	359
3/8/89	1	4	680	30	0.3616	0	0.4	0.0048		1.24	429
5/12/89	6	3.9	750	89	6.4372	0	0.47	0.0339		2.86	489
7/12/90	4	3.9	435	52	2.5073	0	1.72	0.0829		1.87	275
1/7/91	1	4.1	710	122	1.4706	2	4	0.0482		4.27	352
4/30/91	1	3.4	840	96	1.1572	0	219	2.64		4.63	613
9/27/91	1	3.8	1340	110	1.326	0	1.06	0.0127		7.55	886
12/6/91	1	3.9	950	122	1.4706	0	1.37	0.0165		5.28	681
1/31/92	1	3.8	950	100	1.2054	0	0.95	0.0114		4.95	646
4/24/92	1	3.6	1025	108	1.3019	0	0.7	0.0084		6.17	681

SH-3

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/19/88	540	3.2	1040	154	1002.4767	0	2.19	14.2559		10.1	489
10/21/88	210	3.3	1150	162	410.1041	0	2.89	7.316		10.2	613

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/8/89	1000	3.6	630	78	940.2739	0	2.28	27.4849		4.62	393
5/12/89		3.5	620	76		0	1.89			5.16	359
8/3/89	220	3.2	1100	128	339.463	0	2.31	6.1262		2.9	313
11/10/89		3.1	1210	122		0	5.7			14.6	646
3/8/90	260	4.7	900	140	438.7945	0	4.37	13.6966	1.03	10.6	553
5/14/90	310	3.5	740	84	313.9068	0	2.63	9.8282		7.3	458
7/12/90	360	3.3	975	130	564.1643	0	3.09	13.4097		11.6	438
10/8/90	286	3.4	860	130	448.1972	0	5.54	19.1		12.5	448
1/7/91	385	3.6	520	116	538.3671	0	4.97	23.0662		5.8	300
4/30/91	262	3.4	690	104	328.469	0	3.41	10.7699		7.74	513
9/27/91	150	3.1	1525	190	343.5616	0	7.72	13.9594		16.9	886
12/6/91		3.4	810	114		0	5.56			8.05	526
1/31/92	320	4.1	825	108	416.6136	2	5.67	21.8722		7.15	500
4/24/92	388	3.3	805	102	477.0805	0	3.75	17.5397		8.85	478
7/9/92	125	3	1500	166	250.1369	0	4.44	6.6904		17.13	807
10/22/92	200	3	1230	166	400.2191	0	6.16	14.8515		13.1	567
2/12/93	375	3.5	843	146	660	0	6.38	28.841		10.3	344
6/4/93	222	3.2	1370	202	540.5852	0	4.38	11.7216		23	700
7/16/93	210	3.1	1770	224	567.0575	0	4.58	11.5943		22.9	720
10/14/93	160	3.1	1190	184	354.8931	0	9.56	18.439		15.7	567
3/24/94		3.4	868	112		0	6.64			8.97	458
6/22/94	275	3.3	1080	120	397.8082	0	8.14	26.9846		38.24	597
8/16/94	100	3.1	1380	182	219.3972	0	9.18	11.0663		16.5	681
12/2/94	210	4.1	510	54	136.7013	2	3.44	8.7083		4.73	270
3/9/95	575	4.2	167	14	97.041	6	0.44	3.0498		0.99	41
6/19/95	152	3.4	796	86	157.5802	0	3.21	5.8817		7.95	256
9/8/95	60	3.1	1610	192	138.8712	0	8.49	6.1407		21.54	756
12/12/95	275	3.3	711	66	218.7945	0	5	16.5753		7.36	268
2/9/96	1200	3.6	804	96	1388.7123	0	3.83	55.4038		9.75	323
4/29/96	415	3.5	829	112	560.3068	0	2.59	12.957		11.3	365
8/6/96	84	3.1	1240	142	143.7895	0	4.2	4.2529		16.16	515
11/25/96	300	3.8	661	0	0	16	0.63	2.2783		0.78	353
1/15/97		3.5	834	106		0	5.17			13.27	386
5/30/97	500	3.5	678	64	385.7534	0	2.31	13.9232		7	252
7/7/97	180	3.2	1020	120	260.3835	0	2.66	5.7718		9.95	363
10/22/97	280	3.2	1370	164	553.5561	0	6.06	20.4545		16.64	592
2/5/98	500	3.6	697	86	518.3561	0	3.51	21.1561		7.32	273
4/13/98	425	3.7	515	78	399.6164	0	2.52	12.9106		5.27	189
7/23/98	100	3.1	1520	170	204.9315	0	5.05	6.0876		18.77	549
10/6/98	66	3.3	1550	158	125.7073	0	6.36	5.0601		19.44	903
1/21/99	299	3.4	797	72	259.5156	0	6.2	22.3471		7.7	352
5/6/99	288	3.5	630	66	229.1375	0	2.44	8.4711		7.29	205
7/9/99	175	3.1	1260	112	236.2739	0	6.5	13.7123		14.65	463
10/8/99	250	3.4	1330	108	325.4794	0	7.06	21.2767		17.46	587
1/13/00		3.6	841	76		0	5.43			9.49	354
4/20/00		3.6	597	64		0	2.82			5.75	238
7/10/00	250	3.2	1270	120	361.6438	0	6.32	19.0465		16.04	561
12/1/00	250	3.6	720	64	192.8767	0	4.82	14.526		8.24	298
1/12/01	200	3.5	1070	90	216.9863	0	9.28	22.3736		12.12	509
6/4/01	250	3.4	956	90	271.2328	0	4.6	13.863		10.76	386
7/17/01	100	3.1	1620	172	207.3424	0	11.91	14.3572		20.87	788
10/10/01	48	3.2	1570	174	100.6816	0	14.2	8.2165		18.7	882
1/2/02	150	3.4	1040	130	235.0684	0	10.6	19.1671		9.6	456
5/7/02		3.5	649	66		0	2.83			6.18	230
7/10/02	200	3.3	1130	138	332.7123	0	6.84	16.4909		15.3	588
10/25/02	125	3.2	1360	124	186.8493	0	7.64	11.5123		17.9	695

SH-4

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
1/28/86	34	4.23	900	86	35.2482	0	0.01	0.004		2.52	524
2/26/86	136	6.56	500	13	21.3128	21	0.01	0.0163		0.44	282
5/2/86		7.85	500	2		62	0.01			0.01	225
6/5/86	54	4.79	800	28	18.2268	2	0.03	0.0195		1.75	436
9/30/86	15.9	4.29	1100	140	26.8339	0	0.1	0.0191	23	3.5	628
10/20/86	19.7	4.39	1000	135	32.0597	1	0.1	0.0237	21	3.8	778
11/6/86	19.7	4.33	1250	164	38.9466	0	0.1	0.0237	23	3.8	708
11/19/86	40.5	4.46	1050	112	54.6805	0	0.1	0.0488	16	3.1	542
12/7/86	74.3	7.33	625	2	1.7913	25	0.1	0.0895	1.9	0.53	320
12/22/86	47.6	6.7	650	5	2.869	28	0.1	0.0573	1.3	0.52	306
1/7/87	50.5	6.6	700	2	1.2175	21	0.1	0.0608	2.7	0.84	366
1/21/87	29.5	6.38	700	12	4.2673	12	0.2	0.0711		1.1	381
2/6/87	34.5	5.85	650	9.5	3.9509	4.5	0.1	0.0415	3.1	1.3	407
2/17/87	29	4.87	650	16	5.5934	2	0.1	0.0349	7.8	1.4	443
5/1/87	40.5	7.69	600	6	2.9293	42	0.1	0.0488	0.1	0.33	300
5/15/87	40.5	6.76	600	4	1.9528	40	0.1	0.0488	1.1	0.4	268
9/19/88	1	7.6	710	0	0	79	0.13	0.0015		0.41	468
10/21/88	1	7.8	800	0	0	80	0.01	0.0001		0.01	419
3/8/89	8	7.9	680	0	0	78	0.03	0.0028		0.01	393
5/12/89	5	7.7	630	0	0	104	0.01	0.0006		0.05	329
8/3/89	3	8	695	0	0	108	0.06	0.0021		0.01	376
7/12/90	3	7.5	200	0	0	42	0.21	0.0075		2	50
1/7/91	4	7.2	560	0	0	98	0.02	0.0009		0.01	294
4/30/91	3	7.6	575	0	0	102	0.01	0.0003		0.03	410
12/6/91	1	5.4	800	32	0.3857	14	21.7	0.2615		0.94	553
1/31/92	1	7.2	1000	0	0	68	0.02	0.0002		0.01	539
4/24/92	2	7.5	645	0	0	96	0.2	0.0048		0.03	376
7/9/92	1	6.2	690	0	0	34	4.58	0.0552		0.33	448
2/12/93	1	7.4	645	0	0	98	0.39	0.0047		0.03	314
3/2/94	12.4	7.2	652	0	0	72	0.01	0.0014		0.03	344
6/22/94	4	7.9	640	0	0	130	0.2	0.0096		46.79	300
8/16/94	1	7.5	800	0	0	142	0.46	0.0055		0.08	336
12/2/94	1	6.5	845	0	0	52	2.61	0.0314		0.26	401
3/9/95	6	7.7	6100	0	0	92	0.03	0.0021		0.07	400
12/12/95	8.6	7.6	657	0	0	86	0.01	0.001		0.01	234
2/9/96	8	7.8	718	0	0	92	0.07	0.0067		0.01	188
4/29/96	6.7	7.7	483	0	0	92	1.01	0.0815		0.05	127
11/25/96	8	6.3	661	0	0	16	0.63	0.0607		0.78	353
1/15/97	8.6	7.8	561	0	0	104	0.1	0.0103		0.03	201
5/30/97	6	7.9	620	0	0	104	0.04	0.0028		0.03	217
7/7/97	2.2	7.9	644	0	0	126	0.04	0.001		0.03	219
2/5/98	12	7.9	2120	0	0	94	0.06	0.0086		0.03	203
4/13/98	6.2	7.8	552	0	0	112	0.04	0.0029		0.03	186
5/6/99	10.8	7.7	559	0	0	86	0.14	0.0182		0.03	170
1/13/00	2	7.6	3750	0	0	80	0.12	0.0028		0.03	257
4/20/00	5	7.8	590	0	0	90	0.2	0.012		0.04	231
7/10/00	1	7.8	699	0	0	100	0.81	0.0097		0.05	275
6/4/01	0.7	7.2	731	0	0	50	0.17	0.0014		0.04	366
5/7/02	8	7	722	0	0	50	0.16	0.0154		0.03	316

SH-6

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
1/28/86		7.2	430	6		51	0.01			0.01	151
2/16/86		7.67	320	3		42	0.03			0.02	138
5/2/86		7.82	400	2		49	0.02			0.02	169
6/5/86		7.78	490	3		56	0.03			0.02	146
9/30/86	3	7.26	500	6	0.2169	70	0.1	0.0036	0.1	0.01	181

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
10/20/86	6.8	8	500	3	0.2459	70	0.1	0.0081	0.1	0.01	195
11/6/86	5.2	7.88	550	3	0.188	71	0.1	0.0062	0.1	0.01	180
11/19/86	8.8	7.39	490	6	0.6364	71	0.1	0.0106	0.1	0.03	154
12/7/86	16	7.82	435	2	0.3857	62	0.1	0.0192	0.1	0.01	135
12/22/86	12	7.54	440	4	0.5786	54	0.1	0.0144	0.1	0.01	154
1/7/87	12	7.4	440	2	0.2893	63	0.1	0.0144	0.2	0.01	171
1/21/87	12	7.77	460	3	0.4339	6.1	0.2	0.0289		0.01	150
2/6/87	10	7.76	420	3.5	0.4219	61	0.1	0.012	0.1	0.01	164
2/17/87	8	7.76	390	2	0.1928	39	0.1	0.0096	0.1	0.01	160
5/1/87	11	8.36	400	1	0.1326	59	0.1	0.0132	0.1	0.01	160
5/15/87	12.5	7.39	440	7	1.0547	62	0.1	0.015	0.1	0.01	180
9/19/88	2.2	7.7	540	0	0	78	0.07	0.0018		0.08	314
10/21/88	2.3	7.6	580	0	0	78	0.01	0.0002		0.01	307
5/12/89	8	7.5	410	2	0.1928	40	0.01	0.0009		0.05	241
8/3/89	1	7.4	390	0	0	40	0.07	0.0008		0.03	123
3/8/90	1	7	510	0	0	94	0.01	0.0001	0.01	0.01	281

SH-7

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/30/86	1	4.11	550	30	0.3616	0	0.1	0.0012		1	239
10/20/86	0.14	5.29	250	3	0.005	2	52	0.0877		1.1	115
11/6/86	0.14	4.75	325	16	0.027	2	13	0.0219		0.81	130
11/19/86	0.85	5.2	280	15	0.1536	3	0.1	0.001		0.54	122
12/7/86	1	4.59	290	6	0.0723	1	6.2	0.0747		0.58	97
1/7/87	1	4.18	275	10	0.1205	0	7.7	0.0928		0.57	134
5/1/87	4.8	4.18	240	8	0.4629	1	6	0.3471		0.76	114
5/15/87	1	4.34	250	28	0.3375	1	2.7	0.0325		0.62	114
9/19/88	1	4.5	500	27	0.3254	6	1.82	0.0219		0.88	344
10/21/88	1	6.5	475	10	0.1205	22	0.67	0.008		0.43	294

SH-13

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/26/86		7.65	320	4		66	0.01			0.01	105
5/2/86		7.97	340	2		66	0.01			0.01	114
9/30/86	3	7.36	550	7	0.2531	117	0.1	0.0036	0.1	0.01	158
11/6/86	12.5	7.84	550	4	0.6027	117	0.1	0.015	0.1	0.01	164
11/19/86	70.8	8.02	500	2	1.7069	101	0.1	0.0853	0.1	0.01	140
12/7/86	139.1	7.9	440	1	1.6768	87	0.1	0.1676	0.1	0.01	106
12/22/86	120.3	7.65	415	4	5.8007	90	0.1	0.145	0.1	0.01	121
1/7/87	114.8	7.71	430	2	2.7677	90	0.1	0.1383	0.1	0.01	85
1/21/87	114.8	7.81	430	4	5.5355	91	0.2	0.2767		0.01	126
2/6/87	70.8	7.86	430	3	2.5604	92	0.1	0.0853	0.1	0.01	141
2/17/87	54.4	8.01	440	3	1.9673	93	0.1	0.0655	0.1	0.01	160
5/1/87	15	8.24	360	2	0.3616	83	0.1	0.018	0.1	0.01	115
5/15/87	80	7.56	390	8	7.715	92	0.1	0.0964	0.1	0.01	125
9/19/88	16	7.9	560	0	0	132	0.03	0.0057		0.08	275
10/21/88	17	7.9	580	0	0	126	0.01	0.002		0.01	275
3/8/89	60	7.9	455	0	0	102	0.01	0.0072		0.1	247
5/12/89	123	7.9	460	0	0	110	0.01	0.0148		0.05	236
8/3/89	17	7.9	495	0	0	108	0.06	0.0122		0.01	294
11/10/89	9	7.7	600	2	0.2169	136	0.01	0.001		0.02	288
3/8/90	12	7.4	450	0	0	100	0.01	0.0014		0.01	252
5/14/90	21	7.6	485	0	0	120	0.01	0.0025		0.01	225
7/12/90	32	7.7	425	0	0	110	0.18	0.0694		0.01	151
10/8/90	18	7.3	473	0	0	128	0.01	0.0021		0.04	247
1/7/91	28	6.9	420	0	0	108	0.01	0.0033		0.01	186
4/30/91	32	7.4	430	0	0	120	0.03	0.0115		0.01	281

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/27/91	6	7.4	660	0	0	144	0.68	0.0491		0.05	352
12/5/91	16	7.4	675	0	0	146	0.01	0.0019		0.04	344
1/31/92	16	7.7	590	0	0	124	0.01	0.0019		0.01	264
4/24/92	42	4.8	860	0	0	150	0.01	0.005		0.01	231
7/9/92	6	7.3	575	0	0	142	0.01	0.0007		0.03	288
10/22/92	12	7.5	629	0	0	144	0.05	0.0072		0.01	288
2/12/93	21	7.8	458	0	0	120	0.01	0.0025		0.01	205
6/4/93	20	7.2	427	0	0	118	0.01	0.0024		0.06	116
7/16/93	10	7.2	544	0	0	132	0.03	0.0036		0.04	220
10/14/93	8	7.6	570	0	0	142	0.01	0.0009		0.05	270
3/2/94	6	7.6	441	0	0	98	0.01	0.0007		0.01	329
6/22/94	25	7.3	452	0	0	124	2.8	0.8438		10.84	193
8/16/94	12	7.5	525	0	0	130	0.18	0.026		0.07	220
12/4/94	15	7.4	575	0	0	126	0.01	0.0018		0.04	225
3/9/95	50	7.6	602	0	0	108	0.01	0.006		0.04	113
6/19/95	20	7.6	523	0	0	144	0.04	0.0096		0.11	102
9/8/95	15	7.5	592	0	0	152	0.01	0.0018		0.01	191
12/12/95	46	7.5	455	0	0	112	0.01	0.0055		0.01	103
2/9/96	55	7.5	456	0	0	86	0.06	0.0397		0.01	98
4/29/96	38	7.6	437	0	0	110	1.1	0.5038		0.04	87
8/6/96	26	7.3	435	0	0	116	0.06	0.0188		0.03	118
11/25/96	52	7.6	378	0	0	106	0.04	0.025		0.03	107
1/15/97	28	7.5	381	0	0	102	0.04	0.0135		0.03	97
5/30/97	2	7.7	434	0	0	120	0.04	0.0009		0.03	92
7/7/97	25	7.4	467	0	0	134	0.04	0.012		0.03	101
10/22/97	25	7.6	577	0	0	134	0.04	0.012		0.03	153
2/5/98	2	7.9	980	0	0	110	0.06	0.0014		0.03	107
4/13/98	38	7.5	370	0	0	98	0.04	0.0183		0.03	87
7/23/98	20	7.4	487	0	0	126	0.04	0.0096		0.22	105
10/6/98	15	7.8	560	0	0	142	0.04	0.0072		0.05	139
1/21/99	12	8	658	0	0	128	0.04	0.0057		0.03	186
5/6/99	25	7.6	381	0	0	92	0.19	0.0572		0.03	81
7/9/99	13	6.9	673	0	0	42	0.64	0.1002		0.16	247
10/8/99	28	7.6	578	0	0	126	0.08	0.027		0.03	173
1/13/00	30	7.7	532	0	0	108	0.04	0.0144		0.03	130
4/20/00	55	7	392	0	0	80	0.16	0.106		0.04	106
7/10/00	28	7.6	467	0	0	15	0.09	0.0303		0.03	130
1/12/01	22	7.6	498	0	0	6	0.12	0.0318		0.03	151
6/4/01	15	7.6	465	0	0	15	0.05	0.009		0.03	135
7/17/01	12	7.2	520	0	0	13	0.07	0.0101		0.03	146
10/10/01	12	7.4	602	0	0	15	0.05	0.0072		0.02	17
12/1/01	25	7.7	526	0	0	7	7.12	2.1457		0.1	152
1/2/02	25	7.4	515	0	0	2	0.14	0.0421		0.01	146
5/7/02	50	7.3	404	0	0	10	0.01	0.006		0.01	103
7/10/02	25	7	449	0	0	15	0.02	0.006		0.02	105
10/25/02	8	7.5	620	0	0	6	0.02	0.0019		0.01	199

SH-16

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
12/1/294	6	4.7	1005	40	2.8931	8	0.01	0.0007		2.48	321
1/28/86	59.7	3.92	1100	208	149.6916	0	0.03	0.0215		4.96	712
2/26/86	284	4.43	650	77	263.6142	0	0.03	0.1027		2.06	426
6/5/86	16	4.31	1000	155	29.8958	0	0.02	0.0038		3.38	632
9/30/86	1	4.15	1200	209	2.5194	0	0.1	0.0012	27	4.3	672
10/20/86	12.4	4.19	1300	283	42.3026	0	0.5	0.0747	38	5.9	950
11/6/86	6.1	4.21	1400	249	18.31	0	0.1	0.0073	33	5	862
11/19/86	59.7	4.3	1300	236	169.8424	0	0.4	0.2878	29	5.1	832
12/7/86	179.6	4.49	900	80	173.2032	0	0.1	0.2165	10	2.4	481
12/22/86	99.9	4.43	850	115	138.4915	0	0.1	0.1204	16	3	55
1/7/87	60.2	4.58	1050	131	95.0665	0	0.2	0.1451	22	3.3	656

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
1/21/87	50.9	4.31	1000	160	98.1742	0	0.2	0.1227		3.4	620
2/6/87	3.38	4.31	700	163	6.6414	0	0.1	0.004	21	3.5	690
2/17/87	41.8	4.29	900	164	82.638	1	0.1	0.0503	25	3.5	630
5/1/87	59.7	4.54	800	61	43.8999	1	0.1	0.0719	9.6	2.4	450
5/15/87	81.7	4.53	900	80	78.7901	1	0.1	0.0984	11	2.8	484
9/19/88	8.89	4.3	1130	136	14.5747	6	0.07	0.0075		3.07	784
10/21/88	9	4.3	1300	148	16.0569	6	0.01	0.001		3.85	886
3/8/89	70	4.4	1025	88	74.2575	6	0.01	0.0084		2.07	807
5/12/89	123	4.4	980	76	112.6882	8	0.07	0.1037		2.09	700
8/3/89	22	4.3	1120	112	29.703	4	0.03	0.0079		2.25	784
11/10/89	1	4.2	1110	112	1.3501	4	0.01	0.0001		3.26	681
3/8/90	37	4.6	920	63	28.0997	8	0.01	0.0044		2.18	629
5/14/90	41	4.4	950	28	13.8389	6	0.01	0.0049		2.24	646
7/31/90	50	4.5	910	54	32.5479	8	0.01	0.006		2.31	582
10/8/90	14	4.3	1142	148	24.9775	8	0.01	0.0016		4.23	832
1/7/91	156	5	750	76	142.9216	12	0.01	0.0188		1.33	429
4/30/91	50	4.8	810	26	15.6712	8	0.01	0.006		1.7	784
9/27/91	1	4.5	1050	60	0.7232	6	0.12	0.0014		2.56	807
12/6/91	1	4.5	950	49	0.5906	7	0.01	0.0001		2.36	663
1/31/92	17	4.5	1175	80	16.3945	6	0.01	0.002		2.68	858
4/24/92	42	4.8	860	16	8.1008	8	0.04	0.0202		1.74	591
7/9/92	4	4.7	925	26	1.2536	8	0.01	0.0004		1.91	582
10/22/92	17	4.3	1300	134	27.4608	10	0.01	0.002		3.86	700
2/12/93	22	4.9	890	34	9.0169	12	0.01	0.0026		1.86	553
6/4/93	12	5.1	788	2	0.2893	8	0.01	0.0014		1.54	468
7/16/93	0.07	4.6	926	0	0	8	1.61	0.0013		1.62	526
10/14/93	1	4.4	857	34	0.4098	6	0.01	0.0001		1.98	500
3/2/94	342	4.8	891	24	98.9457	8	0.01	0.0412		1.7	172
6/22/94	25	5	897	18	5.4246	8	0.24	0.0723		0.01	367
8/16/94	6.89	4.8	1000	32	2.6578	8	0.01	0.0008		2.4	429
3/9/95	36.4	4.9	888	30	13.1638	10	0.11	0.0482		1.91	430
6/19/95	20	4.8	881	8	1.9287	8	0.1	0.0241		1.54	376
9/8/95	1	3.6	918	58	0.6991	0	2.8	0.0337		1.29	443
12/12/95	21.4	4.7	855	12	3.0956	6	0.06	0.0154		1.46	417
2/9/96	26	5	713	4	1.2536	8	0.03	0.0094		0.8	322
4/29/96	26.4	6.3	651	0	0	14	0.67	0.2132		0.81	282
8/6/96	2.4	4.5	792	18	0.5207	6	1.75	0.0506		1.06	395
11/25/96	17	7.9	566	0	0	116	0.04	0.0081		0.03	212
1/15/97	16.7	6.2	680	0	0	14	0.5	0.1006		1	366
5/30/97	9.1	5.8	706	0	0	10	0.69	0.0756		0.8	334
7/7/97	10.8	6.3	782	0	0	14	0.84	0.1093		0.57	373
10/22/97	0.07	4	802	48	0.0405	0	4.2	0.0035		0.8	350
2/5/98	28	6.3	725	0	0	12	0.45	0.1518		0.61	357
4/13/98	22	6.4	635	0	0	18	0.24	0.0636		0.47	302
7/23/98	7.6	7	705	0	0	62	0.47	0.043		0.28	273
10/6/98	1.1	4.7	712	18	0.2386	8	5.88	0.0779		0.84	306
5/6/99	19.6	6.6	665	0	0	14	0.34	0.0803		0.24	299
7/9/99	7.6	6.9	658	0	0	44	0.76	0.0696		0.18	272
10/8/99	1.1	4.3	680	16	0.2121	4	3.38	0.0448		0.71	114
1/13/00	10.8	5.1	850	10	1.3019	8	0.87	0.1132		0.29	416
4/20/00	17.1	6.1	693	2	0.4122	10	0.32	0.0659		0.29	350
7/10/00	2.2	36.2	754	4	0.106	12	9.16	0.2429		0.39	386
12/1/00	3.9	4.8	616	16	0.7522	8	1.58	0.0742		0.8	283
1/12/01	1.1	6.8	835	0	0	34	7.83	0.1038		0.18	398
6/4/01	1.1	7.2	715	0	0	48	0.56	0.0074		0.09	331
7/17/01	1	7.1	739	0	0	54	0.65	0.0078		0.03	343
1/2/02	1.1	6.7	711	0	0	28	3.75	0.0497		0.08	316
5/7/02	4.7	5.3	798	4	0.2266	8	0.05	0.0028		0.21	373
7/10/02	2	6.5	779	0	0	22	124	2.9895		0.24	324
10/25/02	1	6.5	760	0	0	38	0.8	0.0096		0.07	364

SH-26

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
1/28/86		4.25	490	50		0	0.71			5.3	211
2/26/86		4.68	200	9		1	0.23			3.33	101
5/2/86		4.69	500	31		1	0.18			6.04	258
6/5/86		4.57	500	37		1	0.16			6.07	270
9/30/86		4.4	700	46		0	0.1		6.3	8.7	324
11/6/86		4.74	550	27		2	0.1		3.4	5.5	257
12/7/86		4.65	450	31		1	0.2		4.22	4.2	194
1/7/87		4.62	500	34		0	0.4			4.9	266
2/8/87		4.53	500	47		0	0.4		5.1	6.5	285
5/1/87		4.57	500	39		1	0.1			6.5	275
9/19/88	725	4.3	720	90	786.5753	6	0.26	2.2723		8.1	489
10/21/88	300	4.6	760	84	303.7808	6	0.03	0.1084		7.3	500
3/8/89	600	4.5	550	48	347.178	8	0.01	0.0723		4.21	359
5/12/89		4.3	510	50		5	0.22			4.19	344
8/3/89	300	4.3	770	60	216.9863	4	0.03	0.1084		9.3	500
11/10/89	275	4	840	60	198.9041	0	0.23	0.7624		10.5	539
3/8/90	280	4.7	690	54	182.2684	8	0.12	0.405		7.8	526
5/14/90	292	4.4	585	40	140.8	6	0.11	0.3872		5.77	384
7/12/90	360	4.5	550	50	216.9863	6	0.4	1.7358		6.74	359
10/8/90	256	4.2	685	50	154.3013	4	0.16	0.4937		9.41	438
1/7/91		4.5	510	62		4	0.33			6.28	314
4/30/91	300	4.3	525	52	188.0547	4	0.15	0.5424		5.72	448
9/27/91	100	3.4	1175	134	161.5342	0	2.69	3.2427		13.8	807
12/6/91	185	3.7	740	88	196.252	0	2.57	5.7314		7.16	468
1/31/92	200	3.7	760	80	192.8767	0	2.04	4.9183		6.18	478
4/24/92	400	3.7	650	56	270.0273	0	0.55	2.652		6.65	429
7/9/92	210	3.4	1075	84	212.6465	0	0.69	1.7467		11.73	700
10/22/92	325	3.7	902	116	454.4657	0	0.58	2.2723		9.86	489
2/12/93	750	4	770	108	976.4383	0	3.07	27.7561		10.1	458
6/4/93	325	3.9	940	96	376.1095	0	0.25	0.9794		16.5	567
7/16/93	122	3.7	1160	92	135.303	0	0.38	0.5588		13.3	567
10/14/93	210	3.5	959	116	293.6547	0	1.4	3.5441		11.6	553
3/2/94		4.1	596	54		2	1.45			5.64	314
6/22/94	216	4	746	48	124.9841	0	0.08	0.2083		0.01	429
8/16/94	200	3.7	1400	86	207.3424	0	0.92	2.218		11.92	468
12/2/94		4.6	545	30		8	0.23			4.44	294
3/31/95		8.1	531	0		150	0.1			0.01	83
6/19/95	125	4	611	42	63.2876	0	0.18	0.2712		5.86	216
9/8/95	50	4.1	1040	56	33.7534	2	1.09	0.6569		12.19	511
12/12/95	262	4.2	573	34	107.3841	6	1.19	3.7584		5.4	234
2/9/96	500	4.3	749	76	458.0821	4	2.77	16.6958		8.79	319
4/29/96	460	4.8	557	38	210.7178	8	0.44	2.4398		6.04	234
8/3/96	48	4.6	743	40	23.1452	6	0.69	0.3992		10.02	352
11/26/96		4.9	574	18		8	1.98			8.54	284
1/15/97		4.6	633	48		8	1.11			9.84	333
5/30/97		4.4	548	32		4	0.2			5.82	232
7/7/97		3.2	1040	122		0	2.72			10.13	353
10/22/97		5.1	886	36		8	0.47			11.29	4
2/5/98		4.3	601	60		6	0.53			6.33	259
4/13/98		4.5	438	28		10	0.25			4.09	180
7/23/98	56	4.2	925	52	35.1035	6	0.16	0.108		11.07	405
10/6/98	100	4.2	1120	26	31.3424	4	0.74	0.892		12.96	658
1/21/99		3.5	877	60		0	2.93			7.92	368
5/6/99		4.7	519	0		6	0.44			5.16	254
7/9/99		4	517	28		0	1.27			8.84	368
10/8/99	150	3.8	979	50	90.4109	0	1.37	2.4772		13.03	490
1/13/00		4.6	651	34		6	1.1			6.99	278
4/20/00		4.7	474	26		6	0.23			4.23	207
7/10/00		4.8	679	18		6	0.5			8.19	321
12/1/00		5.6	661	14		12	2.19			6.89	264

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
1/12/01		4.3	833	42		4	11.07			7.44	395
6/4/01		4.2	740	44		2	0.73			8.4	361
7/17/01		4.9	825	20		6	0.27			10	396
10/10/01		6.3	829	0		22	1.07			8.06	384
1/2/02		4.4	656	56		4	1			5.84	288
5/7/02		4.7	479	22		6	0.46			4.25	185
7/10/02		4.4	781	58		6	1.94			10.2	342
10/25/02		3.7	1090	72		0	2.04			14	590

SH-35

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/30/86		6.68	140	7		25	6.4		13	0.12	19
11/6/86	3	6.87	140	9	0.3254	24	1	0.0361	0.1	0.03	32
11/19/86	2.2	7.04	140	3	0.0795	20	1.1	0.0291	0.1	0.03	30
12/7/86	40.6	7.46	320	3	1.4682	29	0.2	0.0978	0.1	0.02	96
12/22/86	5.6	7.05	324	2	0.135	17	0.2	0.0135	0.1	0.01	84
1/7/87	7.7	6.94	330	3	0.2784	18	0.6	0.0556	0.1	0.04	178
1/21/87	2.3	7.12	190	9	0.2495	19	1	0.0277		0.01	68
2/6/87	1	7.35	230	6	0.0723	22	1	0.012	0.1	0.12	46
3/1/87	3	7.51	210	5	0.1808	17	0.1	0.0036	0.1	0.01	76
5/15/87	4	7.07	180	5	0.241	24	0.4	0.0192	0.1	0.2	57.6
9/19/88	1	7.5	174	1	0.012	48	0.41	0.0049		0.26	33
3/9/89	1	7.2	300	0	0	30	0.38	0.0045		0.27	47
5/12/89	12	7.2	145	2	0.2893	28	0.13	0.0188		0.17	40
8/3/89	1	7.7	445	0	0	82	0.15	0.0018		0.2	96
11/10/89	2	6.8	195	4	0.0964	34	1.61	0.0388		0.56	51
3/8/90	3	6.6	280	2	0.0723	24	0.02	0.0007		0.02	96
5/14/90	2	7.2	260	0	0	38	0.21	0.005		0.19	48
7/12/90	16	7	133	2	0.3857	36	1.21	0.2333		0.11	31
10/8/90	1	6.8	250	0	0	74	3.6	0.0433		1.15	31
1/7/91	26	6.4	300	6	1.8805	40	0.04	0.0125		0.02	92
4/30/91	7	6.7	200	0	0	20	0.66	0.0556		0.16	85
9/27/91	1	7.1	340	0	0	62	1.18	0.0142		0.46	50
12/6/91	2	6.6	175	0	0	34	0.33	0.0079		0.12	40
1/31/92	1	6.9	400	0	0	34	0.24	0.0028		0.01	125
4/24/92	3	6.9	245	0	0	24	0.07	0.0025		0.06	80
7/9/92	1	7.1	260	0	0	6	1.8	0.0216		0.23	119
10/22/92	1	7.2	320	0	0	92	1.9	0.0229		0.65	30
2/12/93	1	7.2	689	0	0	46	0.34	0.004		0.19	34
6/4/93	1	6.6	239	0	0	32	0.01	0.0001		0.08	89
6/22/94	1	7.3	268	0	0	72	0.1	0.0012		1.54	70
12/2/94	4	6.8	182	0	0	50	0.09	0.0043		0.13	35
3/9/95	4	6.4	742	0	0	38	1.95	0.094		0.34	21
2/9/96	5	6.8	679	0	0	36	0.08	0.0048		0.01	39
4/29/96	10	7.1	214	0	0	40	3.79	0.4568		0.09	15
5/30/97	1	7.4	690	0	0	124	0.34	0.004		0.43	34
2/5/98	8	7.2	526	0	0	44	2.7	0.2603		0.27	25
4/13/98	18	6.1	202	0	0	12	0.04	0.0086		0.03	76
1/13/00	44	7.7	487	0	0	8	0.03	0.0159		0.03	133
4/20/00	10	6.4	222	0	0	9	0.22	0.0265		0.06	89
7/10/00	1	6.5	277	0	0	16	0.19	0.0022		0.03	119
12/1/00	2	6.7	304	0	0	6	0.03	0.0007		0.03	115
1/12/01	4	6.4	332	0	0	3	0.12	0.0057		0.03	129
6/4/01	1	6.3	267	2	0.0241	17	0.14	0.0016		0.04	124
7/17/01	1	6.2	313	4	0.0482	17	1.1	0.0132		0.1	136
5/7/02	2	5.9	252	2	0.0482	10	0.31	0.0074		0.03	95

SH-37

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/30/86		3.36	550	75		0	2		6.8	6.8	200
11/6/86		3.35	800	77		0	7.4		8.8	70	384
12/7/86		3.4	700	111		0	6.3		10	12	358
1/7/87		3.41	750	94		0	7.4			8	350
2/6/87		3.36	600	110		0	7.8		7.5	11	418
5/1/87		3.33	800	99		1	9			0.01	450
9/19/88	320	3	1420	370	1427.2876	0	25.4	97.9813		17.5	629
10/21/88	150	3.3	1410	290	524.3835	0	20.8	37.6109		20.3	613
3/18/89	180	3.2	900	188	407.9342	0	8.8	19.0947		12.9	553
5/12/89	1000	3.3	741	136	1639.452	0	7.1	85.589		7.9	168
8/3/89	25	3.2	1400	166	50.0273	0	4	1.2054		17.5	858
11/10/89	75	3	1350	216	195.2876	0	24.5	22.1506		18.2	613
3/8/90	89	3.5	1250	210	225.3041	0	25.6	27.4656		19	858
5/14/90	100	3.4	1050	164	197.6986	0	10.3	12.4164		13.8	553
7/12/90	182	3.5	550	90	197.4575	0	3.5	7.6789		6.65	376
10/8/90	82	3.3	1000	140	138.389	0	6.38	6.3065		14.8	567
4/30/91	68	3.4	800	112	91.8093	0	4.5	3.6887		10.2	646
9/27/91	100	3.1	1400	108	130.1917	0	12.1	14.5863		17	858
11/7/91	140	3.4	760	140	236.2739	0	6	10.126		11.1	376
12/6/91	200	3.4	800	148	356.8219	0	10.7	25.7972		7.26	500
1/31/92	150	3.3	890	122	220.6027	0	7.52	13.5978		7.82	513
4/24/92	252	3.3	800	104	315.932	0	5.31	16.1307		8.62	478
7/9/92	40	3.1	1310	124	59.7917	0	6.95	3.3512		12.71	807
10/22/92	60	3	1280	164	118.6191	0	9.61	6.9507		14.4	567
2/12/93	125	3.4	1090	178	268.2191	0	11.1	16.726		17.2	629
6/4/93	38	3.2	1470	216	98.9457	0	7.5	3.4356		25.4	681
7/16/93	32	3	2170	276	106.4679	0	11.5	4.4361		25.9	1050
10/14/93	35	3.1	1410	216	91.1342	0	12.9	5.4427		18.4	807
3/2/94		3.4	867	110		0	6.02			8.8	429
6/22/94	75	3	1430	170	153.6986	0	0.34	0.3073		6.72	646
8/19/94	38	3.1	1350	174	79.7063	0	6.97	3.1928		16.71	700
12/2/94	180	3.6	625	90	195.2876	0	5.5	11.9342		4.98	329
3/9/95	100	3.6	616	86	103.6712	0	4.32	5.2076		5.98	207
6/19/95	48	3.3	967	108	62.492	0	3.94	2.2798		10.48	331
9/8/95	10	3	2060	238	28.6904	0	12.03	1.4501		27.3	1016
12/12/95	68	3.2	887	106	86.8909	0	6.42	5.2626		10.6	298
2/9/96	128	3.6	771	104	160.4734	0	4.37	6.7429		9.64	313
4/29/96	75	3.4	998	124	112.1095	0	3.94	3.5621		12.96	397
8/6/96	21	3	1630	230	58.2246	0	8.95	2.2656		21.55	733
11/25/96	88	3.5	912	104	110.3254	0	4.34	4.6039		15.28	513
1/15/97		3.5	935	134		0	7.94			16.11	453
5/30/97	78	3.5	678	74	69.5802	0	2.75	2.5857		6.89	234
7/7/97	20	3.2	1080	120	28.9315	0	2.79	0.6726		10.48	361
10/22/97	35	3.5	1240	134	56.5369	0	6.31	2.6623		17.01	619
2/5/98	222	3.6	718	90	240.8547	0	4.06	10.8652		7.91	290
4/13/98	75	3.6	580	90	81.3698	0	2.79	2.5224		5.53	213
7/23/98	8	3.1	1830	198	19.0947	0	1.93	0.1861		23.08	724
10/6/98	10	3.1	1650	154	18.5643	0	13.94	1.6804		16.37	873
1/21/99		3.5	812	92		0	7.93			7.67	333
5/6/99	188	3.4	789	86	194.9019	0	4.34	9.8357		10.03	299
7/9/99	8	3.1	1400	134	12.9227	0	9.38	0.9045		18.42	592
10/8/99	25	3.4	1140	114	34.3561	0	8.96	2.7002		13.66	506
1/13/00	4	3.6	801	78	3.761	0	5.32	0.2565		9.11	343
4/20/00	175	3.6	548	62	130.7945	0	3.32	7.0038		5.73	232
7/10/00	28	3.2	1230	124	41.8542	0	6.63	2.2378		17.02	558
12/1/00	125	3.6	761	72	108.4931	0	5.7	8.589		8.56	312
1/12/01	45	3.4	1050	98	53.1616	0	7.94	4.3071		10.62	500
6/4/01	75	3.4	955	84	75.9452	0	4	3.6164		10.25	422
7/17/01	35	3.1	1610	152	64.1315	0	12.09	5.1009		21.07	769
10/10/01	12	3.1	1560	174	25.1704	0	12	1.7358		17.1	906
1/2/02		3.4	1040	130		0	10.9			9.99	513

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
5/7/02	200	3.5	640	64	154.3013	0	2.89	6.9676		6.26	231
7/10/02	38	3.3	1140	138	63.2153	0	7.09	3.2478		15.7	675
10/25/02	25	3.2	1390	150	45.2054	0	13.5	4.0684		18.7	765

SH-38

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/30/86		6.87	475	16		110	0.1		0.1	0.03	79
11/6/86		7.31	500	8		115	0.1		0.1	0.01	100
12/7/86		7.16	400	14		73	0.1		0.1	0.01	99
1/7/87		6.79	415	23		77	0.1			0.01	134
2/6/87		7.52	400	5.3		85	0.1		0.1	0.01	181
5/1/87		7.28	390	5		175	0.1			0.01	143
9/19/88		7.4	440	3		100	0.06			0.1	96
10/21/88		7.7	450	8		112	0.02			0.01	116
1/5/89		7.8	427	0		76	0.01			0.01	220
5/12/89		7.5	410	0		66	0.01			0.09	116
8/3/89		7.1	510	0		86	0.01			0.02	336
9/27/91		6.9	525	0		90	0.17			0.07	241
1/31/92		6.8	375	0		40	0.1			0.01	193
4/24/92		6.5	360	0		38	0.03			0.02	220
7/9/92		7.1	350	0		50	0.06			0.04	200
2/12/93		6.6	382	0		58	0.15			0.1	110
6/4/93		6.5	398	0		56	0.07			0.29	172
7/16/93		7.2	518	0		108	1.52			1.69	116
10/14/93		6.9	420	0		82	0.01			0.06	215

SH-41

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
9/30/86		5.24	750	69		4	7.6		0.5	1.9	351
12/7/86		7.52	300	13		95	0.2		0.1	0.05	39
1/7/87		7.77	315	10		97	0.3			0.08	65
5/1/87		7.94	260	4		102	0.1			0.01	68
5/28/87		7.8	240	0		110	0.3			0.08	81
9/19/88		6.4	650	58		11	16.8			1	367
10/21/88		6.3	600	36		14	8.7			1.05	247
3/5/89		7.3	430	0		66	0.18			0.34	252
5/12/89		7.7	440	0		126	0.41			0.16	123
8/3/89		7.3	600	0		88	0.45			0.61	419
12/28/89		6	825	100		12	31.5			1.7	513
3/8/90		7.1	340	0		94	4.38			0.11	63
5/14/90		6.7	640	0		64	6.48			1.05	344
7/12/90		6	700	30		14	12.3			1.71	429
4/30/91		6.5	490	0		54	18.7			1.04	384
9/27/91		6.1	810	30		20	34.3			1.4	629
12/6/91		5.6	1000	130		10	43.9			2.23	663
1/31/92		6.4	700	0		28	22.5			0.91	429
4/24/92		7	290	0		90	4.73			0.08	148
2/12/93		7.2	535	0		98	4.34			0.17	252
6/4/93		6.4	730	0		32	22.5			1.63	458
7/16/93		6.2	865	48		20	33.2			1.62	458
10/14/93		6.5	814	60		38	47.7			1.53	500

SH-55

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
11/7/86	3	6.74	170	4	0.1446	8	0.1	0.0036	0.1	0.01	55
12/8/86	8	6.88	145	3	0.2893	11	0.1	0.0096	0.1	0.01	42
1/7/87	2	6.79	140	2	0.0482	8	0.7	0.0168		0.02	22
2/6/87	1	7.01	145	5	0.0602	21	0.1	0.0012	0.1	0.01	45
5/1/87	2	7.37	100	4	0.0964	20	0.1	0.0024		0.01	26

SH-64

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
12/7/86	6	5.87	220	2	0.1446	2	0.1	0.0072	0.1	0.04	90
1/7/87	2	6.03	240	3	0.0723	2	0.1	0.0024		0.03	98
6/26/89	14	5.2	230	10	1.6876	4	0.11	0.0185		0.1	89
8/3/89	1	6	300	14	0.1687	8	0.01	0.0001		0.05	247
11/10/89	1	6	240	4	0.0482	8	0.01	0.0001		0.08	92
3/8/90	1	5.6	300	6	0.0723	8	0.08	0.0009		0.06	116
5/14/90	5	6	295	3	0.1808	8	0.02	0.0012		0.06	123
7/12/90	12	6.1	155	4	0.5786	8	0.28	0.0405		0.08	61
12/8/90	2	6	285	4	0.0964	10	0.01	0.0002		0.11	220
1/7/91	12	5.6	250	6	0.8679	8	0.01	0.0014		0.05	83
4/30/91	6	6.1	250	0	0	10	0.07	0.005		0.05	105
12/6/91	6	5.3	350	0	0	6	0.03	0.0021		0.12	247
1/31/92	5	5.9	360	0	0	8	0.03	0.0018		0.01	236
4/24/92	8	6.1	245	0	0	14	0.32	0.0308		0.06	100
7/9/92	1	6.3	325	0	0	12	0.011	0.0001		0.22	225
10/22/92	1	6.2	356	0	0	14	0.05	0.0006		0.04	205
2/12/93	2	6.4	272	0	0	14	0.01	0.0002		0.02	100
6/4/93	1	6.2	253	0	0	10	0.06	0.0007		0.08	96
3/2/94	10	5.3	269	0	0	6	0.03	0.0036		0.1	85
6/22/94	2	6.3	272	0	0	14	0.11	0.0026		0.01	100
8/16/94	1	6.2	290	0	0	10	0.04	0.0004		0.13	123
12/2/94	12	5.7	290	0	0	8	0.01	0.0014		0.12	100
3/9/95	8	5.9	227	0	0	12	0.01	0.0009		0.11	87
6/19/95	2	6.4	295	0	0	12	0.02	0.0004		0.15	95
12/12/95	11	5	276	0	0	6	0.01	0.0013		0.03	89
2/9/96	9	5.8	259	0	0	12	0.01	0.001		0.01	101
4/29/96	4	5.9	139	0	0	10	0.17	0.0081		0.04	46
8/6/96	1	6.2	258	0	0	12	0.04	0.0004		0.03	114
11/25/96	3	6.3	233	0	0	14	0.04	0.0014		0.03	105
1/15/97	8	6.3	219	0	0	8	0.04	0.0038		0.03	87
5/30/97	8	6.4	219	0	0	12	0.04	0.0038		0.04	76
7/7/97	2	6.5	275	0	0	16	0.04	0.0009		0.03	91
10/22/97	1	6.3	298	0	0	12	0.04	0.0004		0.03	126
2/5/98	5	6.6	224	0	0	12	0.04	0.0024		0.03	88
4/13/98	12	6	205	0	0	12	0.04	0.0057		0.03	75
1/21/99	3	7.9	656	0	0	126	0.04	0.0014		0.03	186
5/6/99	8	6.2	240	0	0	8	0.24	0.0231		0.04	90
7/9/99	2	6.1	296	0	0	10	0.62	0.0149		0.21	99
10/8/99		6.3	324	2		10	0.1			0.05	137
1/13/00	4	6.6	290	0	0	12	0.03	0.0014		0.03	111
4/20/00	11	6.5	222	2	0.2652	10	0.23	0.0304		0.07	88
7/10/00	4	6.5	277	0	0	15	0.26	0.0125		0.03	122
12/1/00	1.5	6.1	294	4	0.0723	7	0.03	0.0005		0.03	113
1/12/01	1	6.1	333	2	0.0241	4	0.12	0.0014		0.03	129
6/4/01	2	6.6	278	0	0	15	0.14	0.0033		0.04	124
7/17/01	1	6.2	314	0	0	13	0.19	0.0022		0.06	143
1/2/02	1	5.7	344	10	0.1205	2	0.02	0.0002		0.02	145
5/7/02	5	5.8	253	4	0.241	11	0.03	0.0018		0.02	93
7/10/02	1	4.3	322	8	0.0964	15	0.04	0.0004		0.03	95

SH-66

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
2/3/88	5	7.6	480	0	0	82	0.06	0.0036		0.01	230
2/16/88	7.2	7.7	390	0	0	70	0.02	0.0017		0.08	210
3/1/88	5.1	7.6	385	0	0	76	0.01	0.0006		0.01	210
3/15/88	19.7	7.5	420	0	0	70	0.01	0.0023		0.09	193
4/1/88	24	7.4	380	0	0	77	0.01	0.0028		0.03	200
4/18/88	29	7.3	120	0	0	75	0.02	0.0069		0.03	180
9/19/88	3.5	7.9	620	0	0	102	0.03	0.0012		0.02	86
10/21/88	2.21	7.5	525	0	0	110	0.01	0.0002		0.01	110
3/5/89	35	7.7	455	0	0	76	0.01	0.0042		0.01	220
5/12/89	5	7.7	510	1	0.0602	70	0.03	0.0018		0.04	110
8/3/89	3	7.7	430	0	0	88	0.01	0.0003		0.01	110
11/10/89	1	7.1	540	0	0	96	0.25	0.003		0.06	100
3/8/90	3	6.7	410	0	0	70	0.01	0.0003		0.01	110
5/14/90	5	7.5	440	0	0	84	0.01	0.0006		0.01	116
7/12/90	18	7.6	425	0	0	94	0.05	0.0108		0.01	100
10/8/90	1	6.8	315	0	0	88	0.01	0.0001		0.03	92
1/7/91	2	66.4	330	0	0	46	0.01	0.0002		0.01	81
4/30/91	10	6.9	350	0	0	70	0.01	0.0012		0.01	172
12/6/91	1	6.6	760	0	0	92	0.01	0.0001		0.03	176
1/31/92	1	7.2	610	0	0	92	0.01	0.0001		0.01	205
4/24/92	3	6.8	440	0	0	72	0.01	0.0003		0.01	210
7/9/92	1	7.1	500	0	0	92	0.01	0.0001		0.01	186
10/22/92	1	6.8	628	0	0	112	1.35	0.0162		0.22	83
2/12/93	1	6.8	535	0	0	52	0.01	0.0001		0.01	138
6/4/93	1	6.9	484	0	0	78	0.02	0.0002		0.03	72
7/16/93	1	7	544	0	0	128	0.24	0.0028		0.04	220
10/14/93	1	6.9	625	0	0	116	0.01	0.0001		0.07	172
3/2/94	2	7.6	438	0	0	98	0.01	0.0002		0.03	110
6/22/94		7.6	436	0		130	0.11			0.01	179
8/19/94	1	7.6	540	0	0	132	0.01	0.0001		0.03	225
12/4/94	2	7.4	560	0	0	130	0.01	0.0002		0.08	264
3/9/95	5	7.5	598	0	0	108	0.01	0.0006		0.05	110
6/19/95	4	7.6	512	0	0	146	0.03	0.0014		0.11	103
9/8/95	1	7.6	594	0	0	146	0.09	0.001		0.01	188
12/12/95	1	7.7	454	0	0	100	0.09	0.001		0.01	108
2/9/96	2	7.3	462	0	0	84	0.01	0.0002		0.01	101
4/29/96	4	7.5	436	0	0	106	1.01	0.0487		0.03	90
8/6/96	1	7.3	429	0	0	114	0.04	0.0004		0.03	111
11/25/96	3	7.7	380	0	0	104	0.04	0.0014		0.03	112
1/15/97	2	7.5	380	0	0	100	0.16	0.0038		0.05	97
5/30/97	32	7.7	435	0	0	122	0.13	0.0501		0.06	96
7/7/97	1	7.5	486	0	0	132	0.04	0.0004		0.03	101
10/22/97	1	7.6	566	0	0	136	0.18	0.0021		0.03	159
2/5/98	62	7.8	980	0	0	102	0.05	0.0373		0.03	106
4/16/98	8	7.4	363	0	0	94	0.29	0.0279		0.03	88
7/23/98	1	7.2	490	0	0	128	0.14	0.0016		0.18	107
10/6/98	1	7.6	590	0	0	140	0.37	0.0044		0.15	131
1/21/99	1	8	656	0	0	128	0.11	0.0013		0.04	182
5/6/99	1	7.6	381	0	0	92	0.49	0.0059		0.08	103
10/8/99	1	7.7	573	0	0	120	5.75	0.0693		0.28	376
1/13/00	1	7.8	490	0	0	110	10.15	0.1223		0.4	132
4/20/00	1	7.7	390	0	0	98	3.21	0.0386		0.15	106
7/10/00	1	7.7	464	0	0	114	0.17	0.002		0.03	134
12/1/00	1	7.7	529	0	0	118	8.21	0.0989		0.12	151
1/12/01	1	7.6	502	0	0	106	1.45	0.0174		0.07	152
6/4/01	1	7.7	512	0	0	112	7.53	0.0907		0.27	122
1/2/02	1	7.4	511	0	0	112	0.06	0.0007		0.01	151
5/7/02	1	7.3	400	0	0	98	0.7	0.0084		0.03	98
9/1/2791	1	6.6	575	0	0	100	0.28	0.0033		0.08	225

3266BSM10 (Thompson Bros)

TB-1

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/15/82	1000	3.49	400	107	1289.863	0	3.79	45.6876		3.78	164
6/21/82	1000	2.78	500	94	1133.1506	0	1.92	23.1452		6.68	250
9/7/82	150	3.18	850	164	296.5479	0	3.4	6.1479		12.8	361

TB-4

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/15/82	2000	3.75	320	58	1398.3561	0	1.66	40.0219		2.86	129
3/15/82	2000	3.75	320	58	1398.3561	0	1.66	40.0219		2.86	129
6/21/82	3000	2.84	500	7	253.1506	0	1.3	47.0136		4.9	224
6/21/82	3000	2.84	500	7	253.1506	0	1.3	47.0136		4.98	224
9/7/82	500	3.23	900	79	476.1643	0	2.41	14.526		8.66	197
9/7/82	500	3.23	900	79	476.1643	0	2.41	14.526		8.66	197
12/7/82	500	3.5	600	78	470.1369	0	1.6	9.6438		5.72	241
2/24/83	750	3.6	500	694	6274.5205	0	1.65	14.9178		4.72	219
5/26/83	1500	3.54	500	107	1934.7945	0	1.92	34.7178		4.95	225
8/18/83		3.26	800	107		0	1.86			8.11	400
12/6/83	800	3.61	340	86	829.3698	0	2.58	24.881		5.11	196
3/14/84		3.54	480	76		0	3.66			7.56	332
5/25/84	1000	3.48	350	69	831.7808	0	1.96	23.6273		5.19	228
9/7/84	200	3.29	600	218	525.589	0	2.69	6.4854		10.1	392
11/8/84	150	3.49	450	75	135.6164	0	2.63	4.7556		8.33	306
12/27/84	1150	3.21	700	72	998.1369	0	4.99	69.1764		10.5	387
2/28/85	800	3.39	580	70	675.0684	0	3.08	29.703		5.55	247
5/15/85		3.33	725	93		0	5.1			9.1	373
8/22/85		2.9	1190	196		0	4.31			12.3	475
11/21/85		3.79	400	126		0	1.3			8.55	161
1/16/86	8	3.23	850	189	18.2268	0	4.03	0.3886		11.7	492
6/10/86		3.23	600	89		0	3.11			8.55	300
8/8/86	275	3.13	900	202	669.6438	0	3.02	10.0115		11.2	499
11/10/86	2000	3.54	350	75	1808.2191	0	1.91	46.0493		4.24	164
2/23/87		3.3	900	299		0	6.47			9.03	396
5/12/87	570	3.28	670	83	570.3123	0	2.39	16.4222		7.8	270
8/11/87	200	3.34	1100	251	605.1506	0	4.35	10.4876		12.6	463
11/2/87	120	3.04	750	87	125.852	0	4.18	6.0466		8.62	388
3/14/88	1400	3.67	440	76	1282.6301	0	4.13	69.7008		6.09	225
6/1/88	510	3.31	830	165	1014.4109	0	3.91	24.0384		9.06	398
7/29/88	150	3.05	1370	363	656.3835	0	8.85	16.0027		14	560
10/31/88	350	3.1	1230	141	594.9041	0	13.8	58.2246		12.3	517
2/6/89	750	3.46	1000	200	1808.2191	0	6.11	55.241		7.52	391
4/27/89	719	3.36	1060	234	2028.1709	0	5.19	44.9837		13.5	624
8/3/89	729	3.16	1400	303	2662.7473	0	7.95	69.8641		20.1	615
11/2/89	249	3.2	1200	258	774.4241	0	11.9	35.7195		14	600
2/7/90	2940	3.76	500	74	2622.641	0	3.41	120.8541		6.45	235
6/5/90	1562	3.19	800	119	2240.721	0	4.94	93.0181		10	437
8/7/90	1125	3.28	800	112	1518.9041	0	3.9	52.8904		9.03	314
11/29/90	920	3.25	1200	175	1940.8219	0	5.01	55.5629		13.2	368
1/23/91	4100	3.25	700	171	8451.6164	0	9.46	467.5572		12.2	435
4/25/91	4633	3.35	500	127	7092.9326	0	7.02	392.066		6.47	256
8/19/91	153	2.87	1400	287	529.338	0	16.8	30.9856		24.9	984
12/5/91	3850	3.12	490	133	6172.6575	0	10.6	491.9561		7.17	289
3/12/92	1440	3.14	650	170	2951.0136	0	9.12	158.3132		8.28	294
6/29/92	125	2.98	1950	445	670.5479	0	17.7	26.6712		25.1	1013
9/29/92	400	3.01	1000	159	766.6849	0	12.8	61.7205		13.6	538
12/28/92	800	3.19	775	201	1938.4109	0	12.9	124.4054		9.54	417
10/1/94	1086	3.18	1420	137	1793.5364	0	11	144.0065		16.6	631

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/28/95	1450	3.32	1050	102	1782.9041	0	5.51	96.3117		10.4	416
6/28/95	840	3.19	1100	123	1245.5013	0	5.71	57.8196		9.4	312
9/25/95	250	3.01	1500	229	690.1369	0	16.1	48.5205		24.1	946
3/27/96	850	3.52	720	91	932.4383	0	4.91	50.3106		9.53	313
6/13/96	310	3.18	1800	170	635.2876	0	10	37.3698		18	685
9/26/96	251	3.46	740	123	372.1676	0	3.74	11.3163		11.9	415
11/21/96	86	3.51	730	100	103.6712	0	3.45	3.5766		8.23	457
1/8/97	133	3.4	700	121	193.9978	0	7.73	12.3934		11.9	421
4/24/97	187	3.4	700	88	198.3736	0	6.07	13.6832		13.8	439
8/7/97	40	2.98	1550	178	85.8301	0	13.6	6.5578		23.8	874
10/13/97	13	3.04	1350	249	39.0213	0	17.7	2.7738		25.3	862
2/6/98	445	3.41	640	136	729.5561	0	4.76	25.5344		7.98	362
5/11/98	343	3.35	675	141	583.006	0	3.1	12.8178		9.26	299
7/10/98	129	2.95	1200	266	413.6482	0	9.77	15.193		29.8	807

TB-5

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/15/82	20	3.54	700	65	15.6712	0	15.1	3.6405		6.15	324
3/15/82	20	3.54	700	65	15.6712	0	15.1	3.6405		6.15	324
6/21/82	150	4.13	700	73	132	16	37.5	67.8082		5.83	485
6/21/82	150	4.13	700	73	132	1	37.5	67.8082		5.03	785
12/7/82	5	2.8	1000	121	7.2931	16	3.51	0.2115		8.75	273
2/24/83	35	3.41	700	74	31.2219	0	33.7	14.2186		5.56	350
5/26/83	45	3.45	700	134	72.6904	0	40.5	21.9698		5.91	375
8/19/83	60	4.07	900	104	75.2219	0	38	27.4849		5.5	415
12/6/83	50	5.59	1050	94	56.6575	0	51.5	31.041		6.65	305
5/25/84	80	3.37	500	113	108.9753	0	45	43.3972		6.52	404
9/7/84	40	3.06	550	97	46.7726	0	45.3	21.8432		6	392
11/8/84		3.51	550	131		0	51.5			7.07	430
3/1/85	90	3.07	1110	86	93.3041	0	47.8	51.8597		7.52	4734
5/20/85	80	3.46	950	236	227.5945	0	59.5	57.3808		7.27	466
8/22/85	10	3.65	960	128	15.4301	0	47.8	5.7621		7.25	481
11/21/85	70	4.8	800	145	122.3561	0	56.4	47.5923		7.3	432
1/16/86	10	3.13	920	136	16.3945	0	51.5	6.2082		7.39	495
5/30/86	10	3.24	800	105	12.6575	0	57.3	6.9073		7.92	798
8/8/86	15	4.42	900	125	22.6027	0	60.5	10.9397		8.28	568
11/10/86	7	2.96	1200	297	25.0619	0	54	4.5567		8.37	732
3/4/87	30	3.02	1000	234	84.6246	0	65.4	23.6515		9.41	583
5/12/87	31	3.04	1200	262	97.909	0	77.7	29.0363		27.3	572
8/11/87	11	3.33	1000	277	36.7309	0	76.3	10.1175		9.17	568
11/2/87	140	2.78	940	232	391.5397	0	81.4	137.3764		9.05	588
3/14/88	21	3.81	920	259	65.566	0	91.8	23.2392		10.7	616
6/1/88		3.07	1310	297		0	79.4			11.1	626
7/29/88	50	2.9	1470	365	220	0	104	62.6849		10.6	553
10/31/88	45	2.98	1404	169	91.6767	0	103	55.8739		11.3	622
2/6/89	74	5.3	1800	222	198.0361	0	105	93.6657		11.2	192
4/27/89	84	3.38	1400	275	278.4657	8	106	107.3358		12.8	123
8/3/89	61	3.2	1300	369	271.3413	0	120	88.241		12.4	168
11/2/89	57	3.05	1400	222	152.5413	0	130	89.326		13.7	820
2/9/90	81	5.3	1500	253	247.0389	0	11	10.7408		12.55	888
6/5/90	66	3.01	1300	177	140.8241	10	111	88.3134		13.6	988
8/7/90	38	2.73	1500	233	106.7331	0	123	56.3441		15	956
11/29/90	65	2.85	2000	270	211.5616	0	124	97.1616		16.4	898
1/23/91	65	3.04	1400	270	211.5616	0	131	102.6465		16.3	1128
4/25/91	82	2.95	1960	298	294.5709	0	158	156.1819		16.1	1075
8/19/91	11	22.95	1200	283	37.5265	0	146	19.36		18.4	1000
12/5/91	34	3.44	1600	351	143.8619	0	139	56.9709		15.5	967
3/12/92	54	3.17	2000	282	183.5704	0	144	93.738		18.6	1034

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
6/29/92	20	4.49	2100	284	68.4712	0	140	33.7534		19.6	1078
9/29/92	35	2.9	2120	314	132.4821	17	154	64.9753		20.4	1128
12/28/92	35	5.4	1600	318	134.1698	0	156	65.8191		19.7	1041
10/1/94	47	3	1300	258	146.1764	0	139	78.7539		23.1	1038
12/27/94	37	2.77	2100	252	112.3989	0	150	66.9041		22.9	1121
3/28/95	51	2.91	1100	262	161.0761	0	153	94.0635		23.5	1098
6/28/95	52	3.46	1350	308	193.0695	0	153	95.9079		22.9	1023
9/25/95	9	2.86	1900	309	33.5243	0	92.1	9.9922		22.9	1260
3/27/96	29	3.02	1600	284	99.2832	0	129	45.0969		24.6	1075
6/13/96	31	2.93	2100	283	105.7567	0	167	62.4076		22.2	1106
9/26/96	32	3.64	1400	259	99.9101	0	154	59.406		24.3	1099

TB-6

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/15/82	10	3.59	140	16	1.9287	0	0.94	0.1133		0.78	37
3/15/82	10	3.59	140	16	1.9287	0	0.94	0.1133		0.78	37
6/21/82		2.84	500	89		0	6.43			3.95	167
6/21/82		2.84	500	89		0	6.43			3.95	167
2/24/83	7	3.07	600	93	7.8476	0	15.7	1.3248		6.18	196
5/26/83	15	3.43	360	45	8.1369	0	1.52	0.2748		1.84	84
12/6/83	15	3.48	275	60	10.8493	0	2.65	0.4791		2	68
5/25/84	10	3.47	160	23	2.7726	0	1.41	0.1699		1.3	63
11/8/84	1	3.03	500	181	2.1819	0	5.31	0.064		3.73	257
2/28/85	2	3.78	115	12	0.2893	0	0.79	0.019		0.78	42
5/13/85		3.04	500	60		0	15			3.13	161
11/21/85	4	3.3	280	134	6.4613	0	6.88	0.3317		2.24	76
1/16/86	8	2.63	1490	494	47.6405	0	115	11.0904		15.8	854
4/30/86		2.84	650	157		0	12.5			4.83	191
11/10/86	3	3.65	1500	428	15.4783	0	9.58	0.3464		32.2	811
2/23/87	2	3.6	750	125	3.0136	0	21.4	0.5159		19.4	435
5/12/87	11	2.7	3600	1711	226.8832	0	98.2	13.0215		99.6	3254

TB-23

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/24/82		5.39	155	22		40	0.82			0.36	82
6/21/82		3.76	300	29		2	0.11			1.66	162
6/21/82		2.72	5000	1249		0	362			156	4779
2/24/83		6.1	350	7		5	0.18			1.18	121
5/26/83		6.51	420	5		1	0.77			1.6	149
12/15/83		6.86	175	8		5	0.12			0.36	95
3/15/84		6.31	200	11		6	1.79			1.37	109
6/5/84		5.74	220	18		2	0.62			1.36	143
3/4/85		6.06	300	7		8	3.45			1.57	111
3/5/86		5.63	12	5		10	0.55			0.39	101
3/14/88		5.48	200	27		6	1.81			0.8	75
10/31/88		6.65	120	68		14	0.51			0.04	31
2/14/89		5.37	420	20		6	0.42			1.13	98
8/3/89		5.62	120	8		4	0.29			0.19	38
11/29/89		5.61	280	8		6	0.34			0.47	94
2/7/90		5.51	240	16		8	0.33			0.34	79
6/5/90		5.39	325	14		6	0.16			1.44	118
8/7/90		5.64	300	5		3	2.03			1.41	121
11/29/90		5.52	390	8		3	0.1			1.33	115
1/23/91		6.11	300	4		4	0.08			0.68	82
4/25/91		5.38	270	15		4	0.17			1.1	111
8/19/91		6.25	160	6		6	0.28			0.12	30
12/6/91		6.34	205	5		9	0.36			0.45	48

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
3/12/92		5.32	235	9		3	0.18			0.89	81
6/30/92		6.28	170	5		10	0.07			0.31	48
9/29/92		5.04	240	31		2	0.09			0.58	50
12/28/92		5.39	300	16		7	0.13			0.74	81
9/26/96		6.43	320	6		47	1.03			0.19	95
8/7/97		6.04	680	5		23	0.2			0.33	132

TB-234

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
8/27/81		3.1		150		0	2.58		1.77	7.88	215

TB-235

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
8/27/81		3.7		142		0	2.3		5.72	12.34	280

TB-236

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
8/27/81		3.2		34		0	2.54		22.9	11.21	400

TB-237

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
8/27/81		4.8		128		8	3.47		1.01	5.92	340

TB-238

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
8/27/81		5.9		160		22	39.8		0.05	3.42	360

TB-239

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
8/27/81		3.5		114		0	13.59		4.03	6.2	305

TB-240

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
8/27/81		3		164		0	0.68		8.07	11.57	480

TB-241

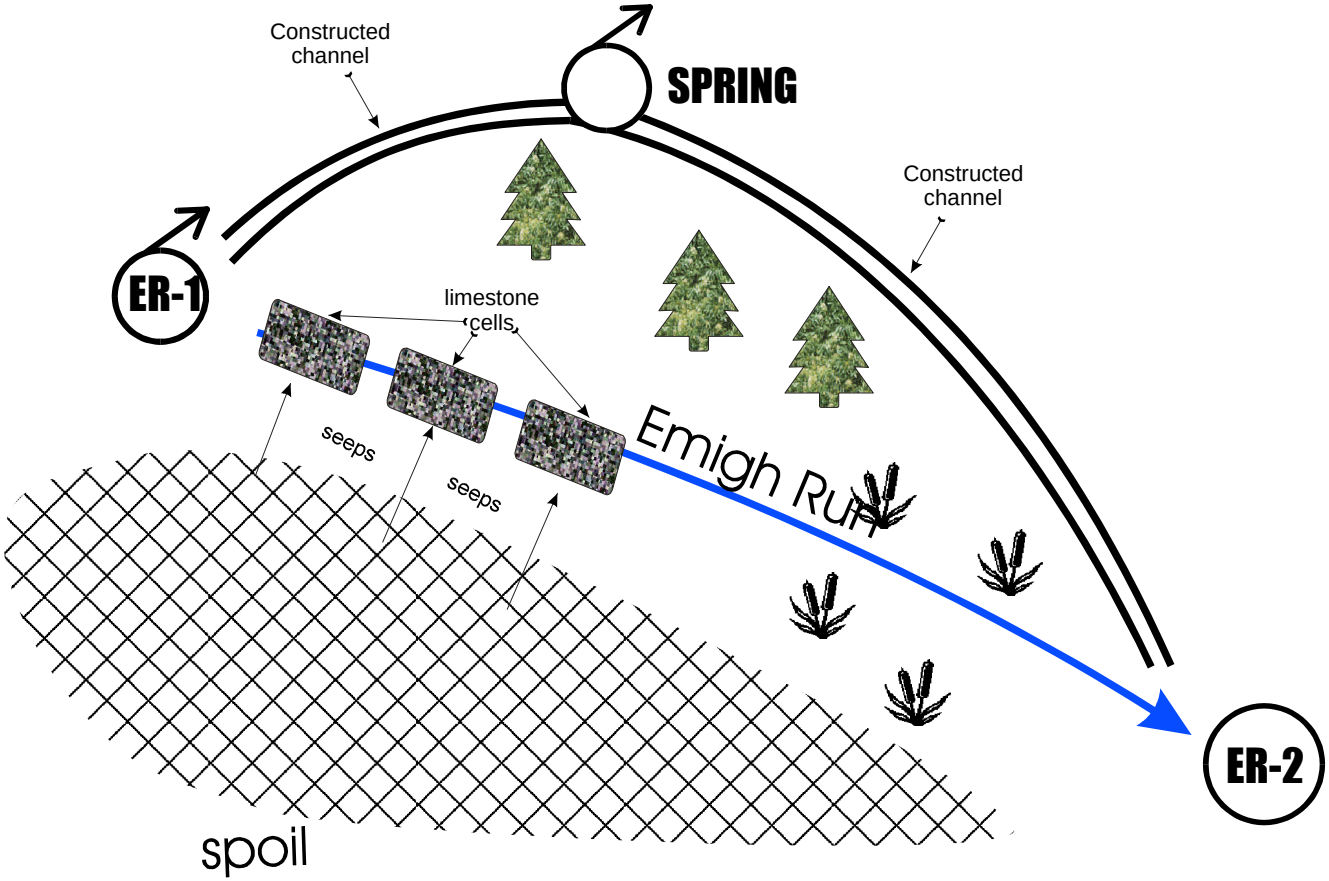
Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
8/27/81		3.3		150		0	3		4.55	7.48	440

TB-242

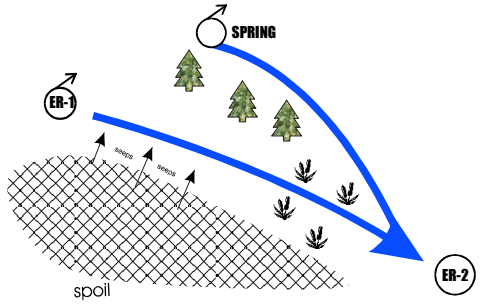
Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
8/27/81		3.3		150		0	2.65		5.39	7.63	425

TB-243

Date	gpm Flow	pH	Umhos /cm Cond	mg / L Acidity	lbs/day Acid Load	mg/L Alk	mg/L Fe	lbs/day Fe Load	mg/L Al	mg/L Mn	mg/L SO4
8/27/81		3.4		154		0	2.1		6.4	6.27	135



Existing layout



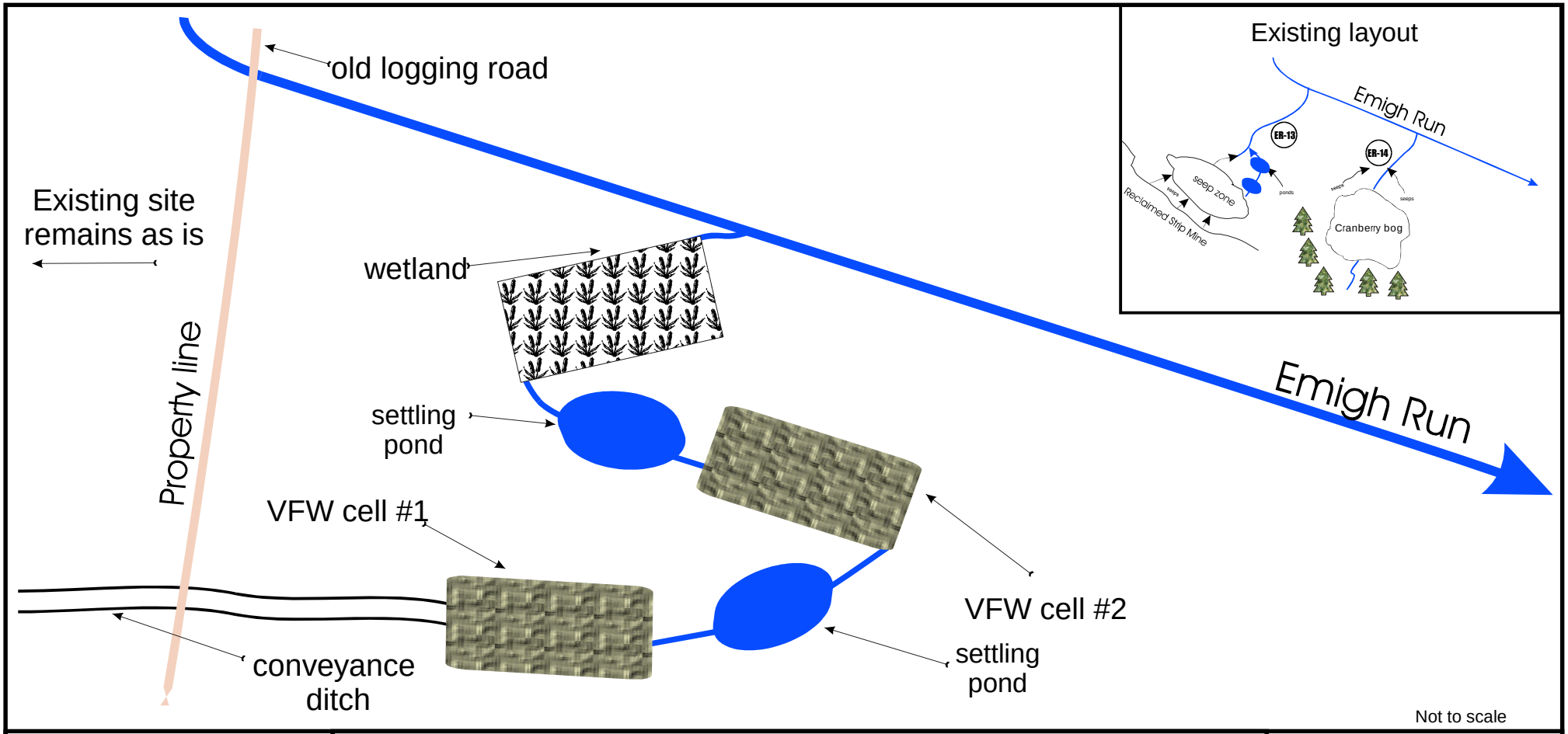
Not to scale

New Miles of Blue Stream NMBS

Proposed Treatment Systems on ER-1, ER-2, and "Spring" Emigh Run Watershed

Prepared by:

NMBS
103 Fairway Drive
Philipsburg, PA 16866
www.newmilesofbluestream.com

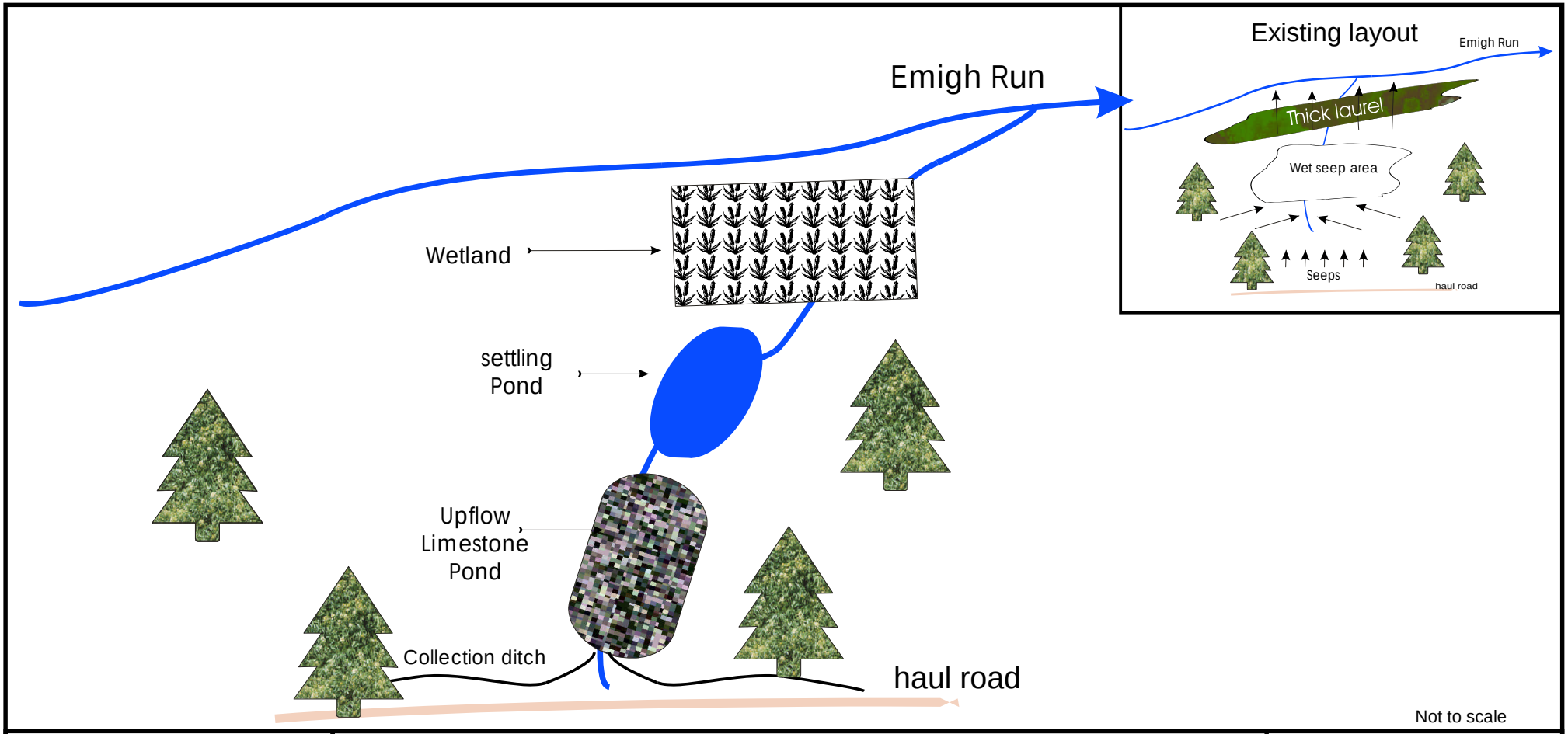


Proposed Treatment Systems on ER-13 and ER-14 Emigh Run Watershed

Prepared by:

NMBS
103 Fairway Drive
Philipsburg, PA 16866

www.newmilesofbluestream.com



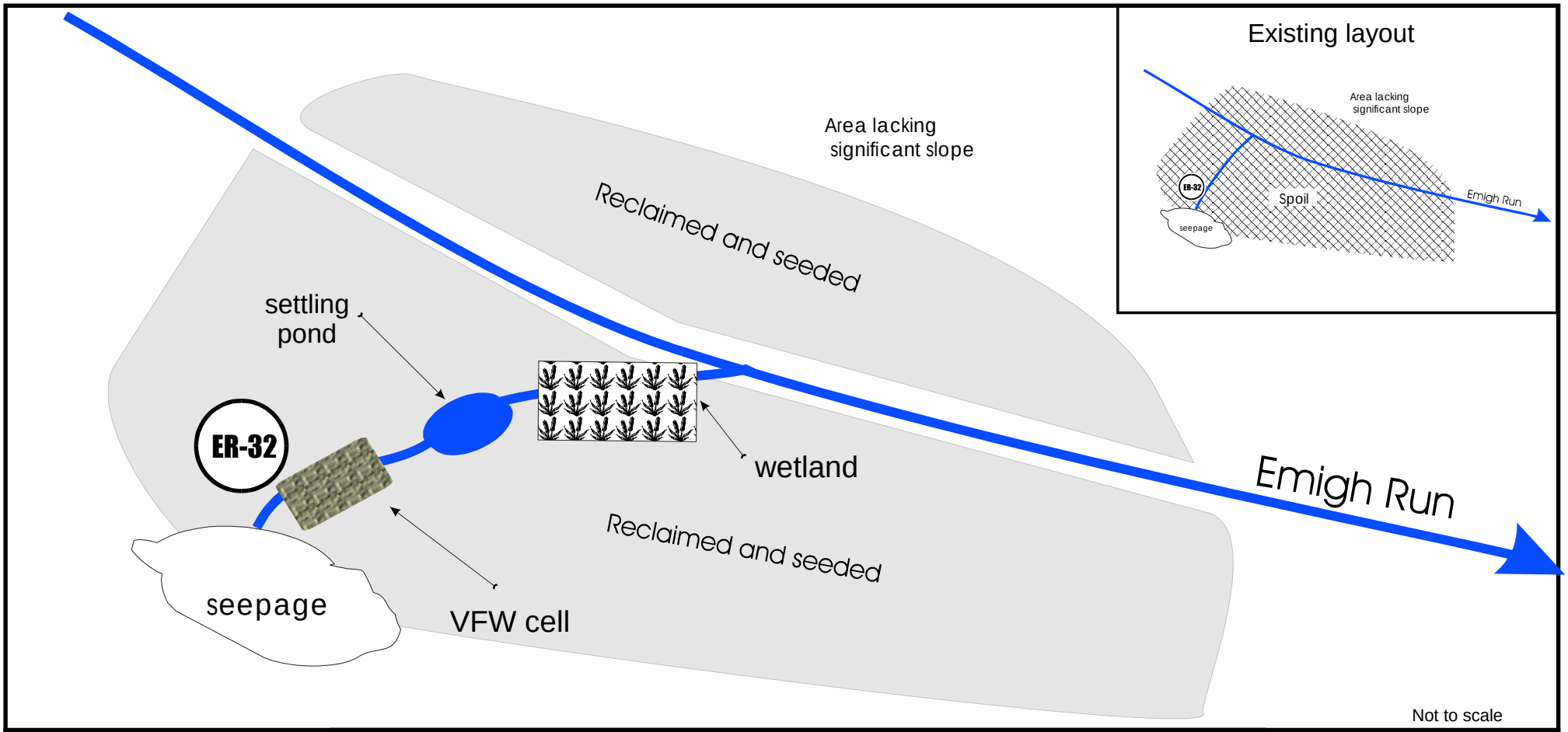
NewMiles of BlueStream
NMBS

Proposed Treatment Systems
on ER-8
Emigh Run Watershed

Prepared by:

NMBS
103 Fairway Drive
Philipsburg, PA 16866

www.newmilesofbluestream.com



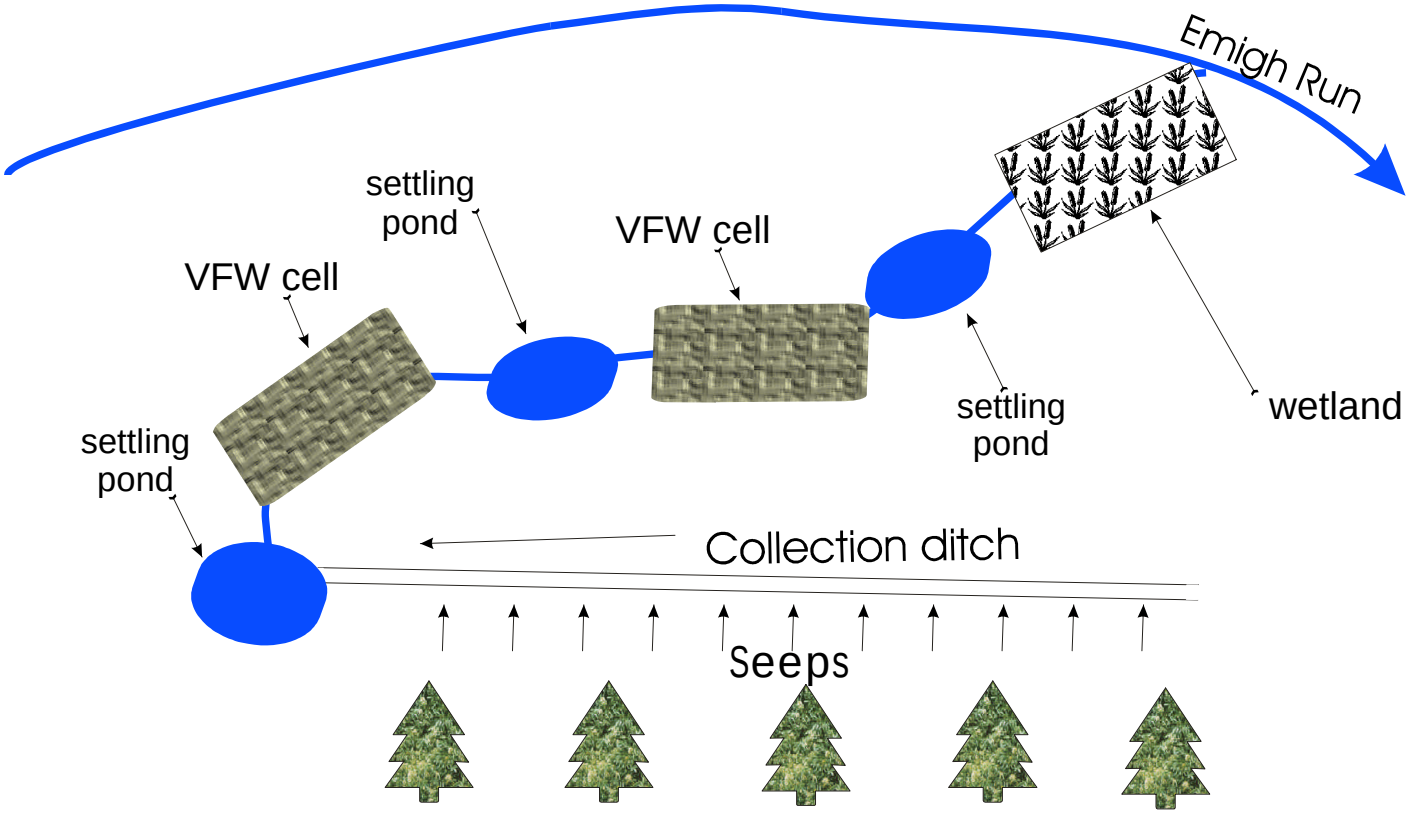
NewMiles of BlueStream NMBS

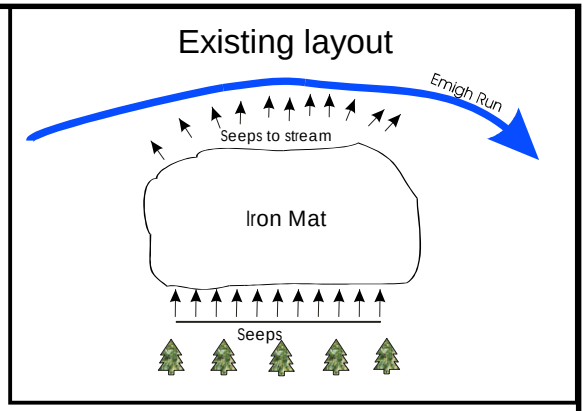
Proposed Treatment Systems
on ER-32
Emigh Run Watershed

Prepared by:

NMBS
103 Fairway Drive
Philipsburg, PA 16866

www.newmilesofbluestream.com





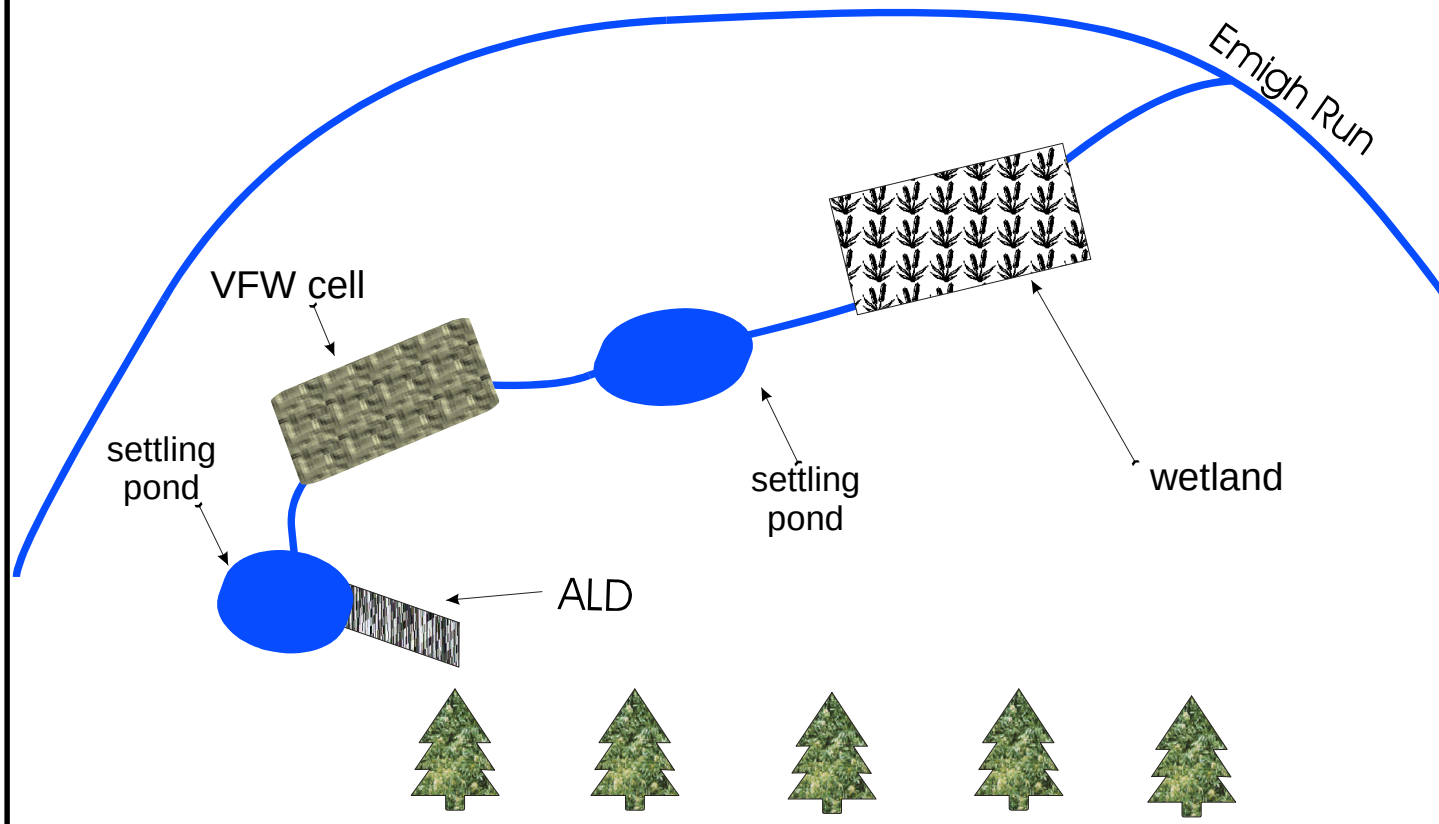
Not to scale

Proposed Treatment Systems on ER-35 Emigh Run Watershed

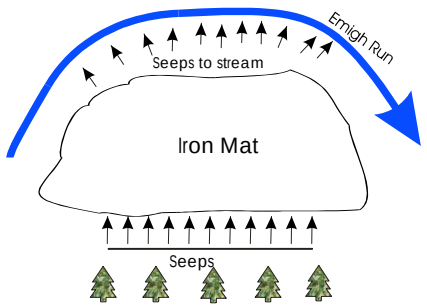
Prepared by:

NMBS
103 Fairway Drive
Philipsburg, PA 16866

www.newmilesofbluestream.com



Existing layout



Not to scale

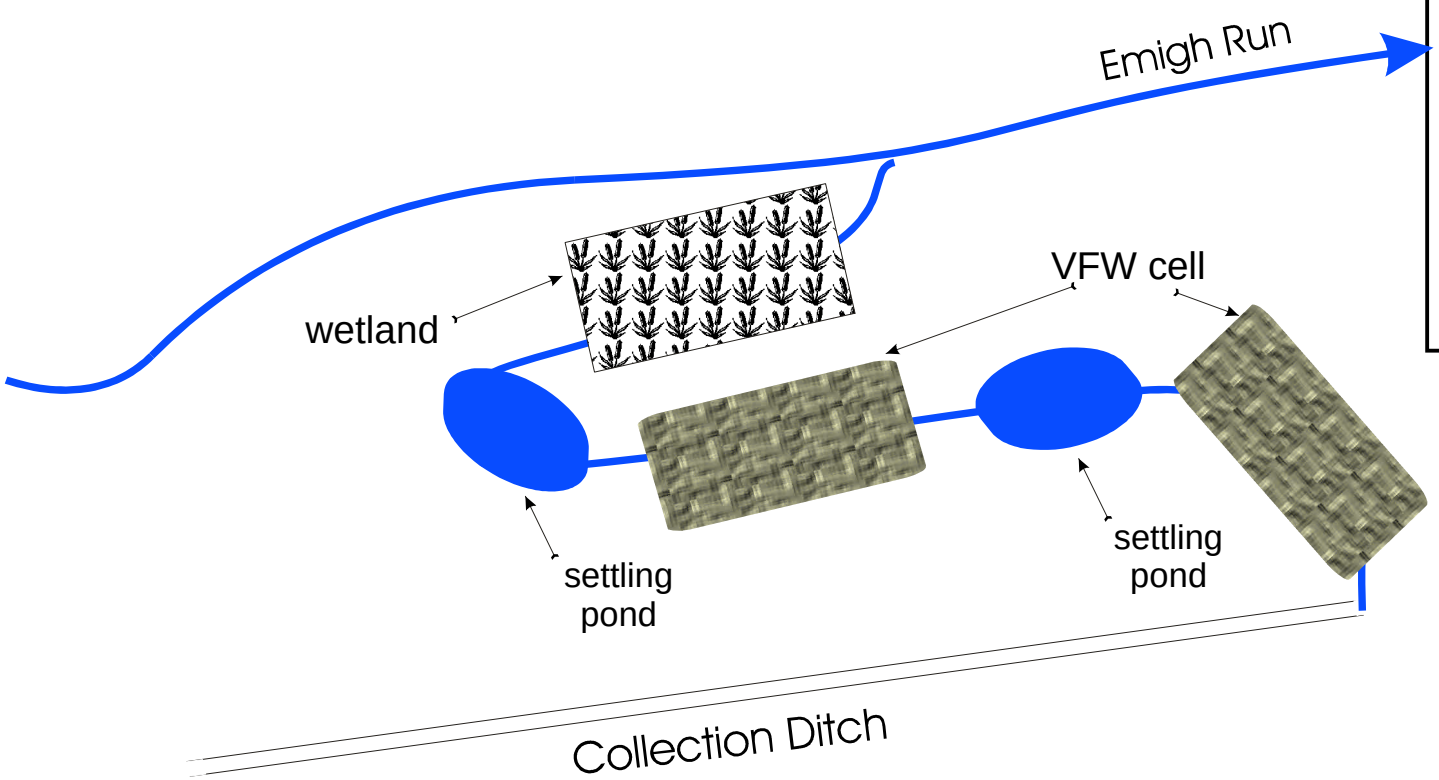
NewMiles of BlueStream NMBS

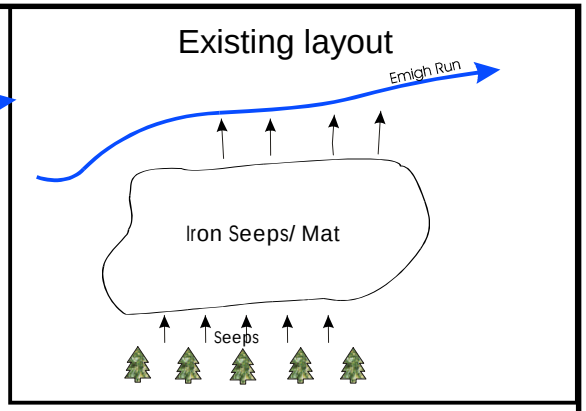
Proposed Treatment Systems on ER-40 Emigh Run Watershed

Prepared by:

NMBS
103 Fairway Drive
Philipsburg, PA 16866

www.newmilesofbluestream.com





Not to scale

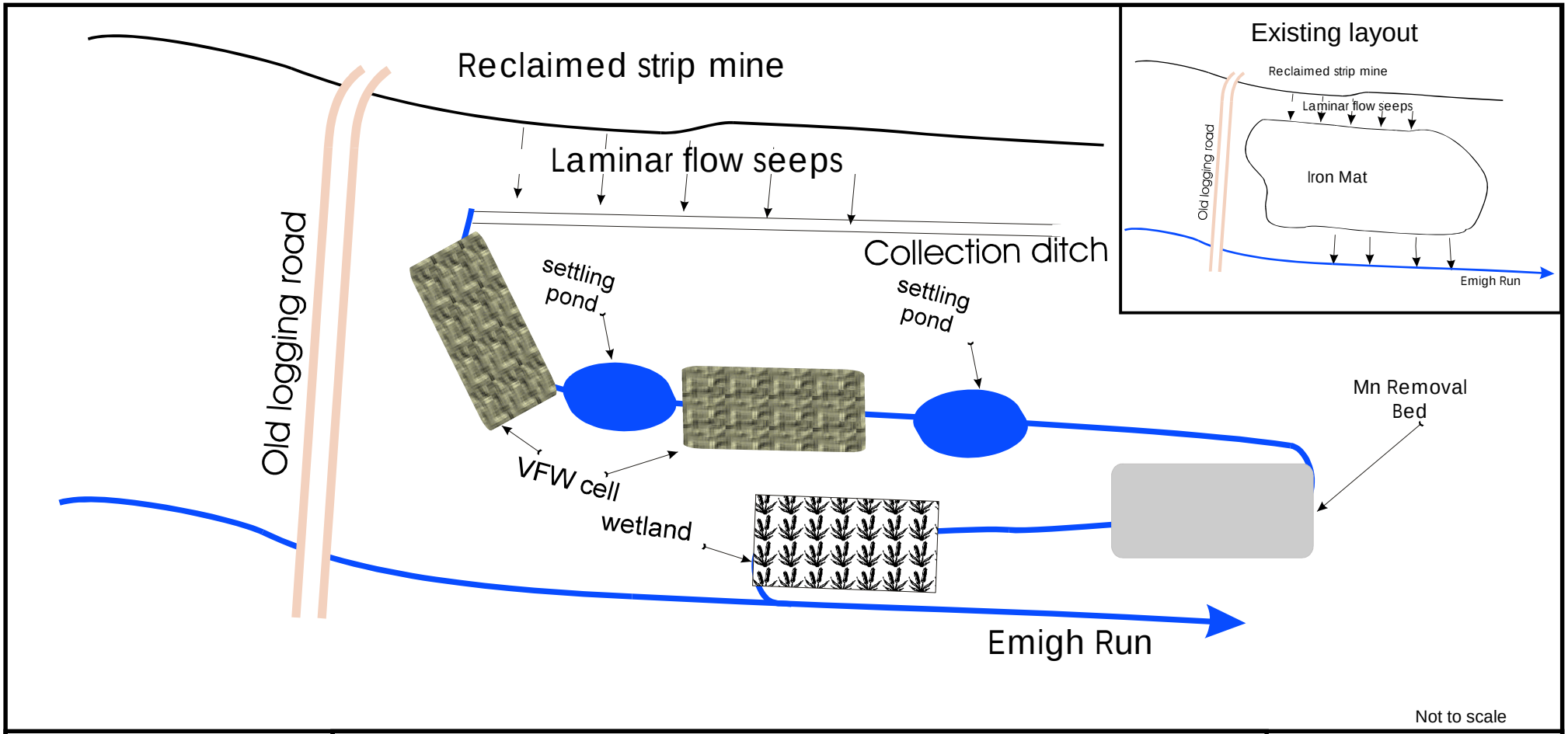
NewMiles of BlueStream NMBS

Proposed Treatment Systems on ER-44 Emigh Run Watershed

Prepared by:

NMBS
103 Fairway Drive
Philipsburg, PA 16866

www.newmilesofbluestream.com



Not to scale

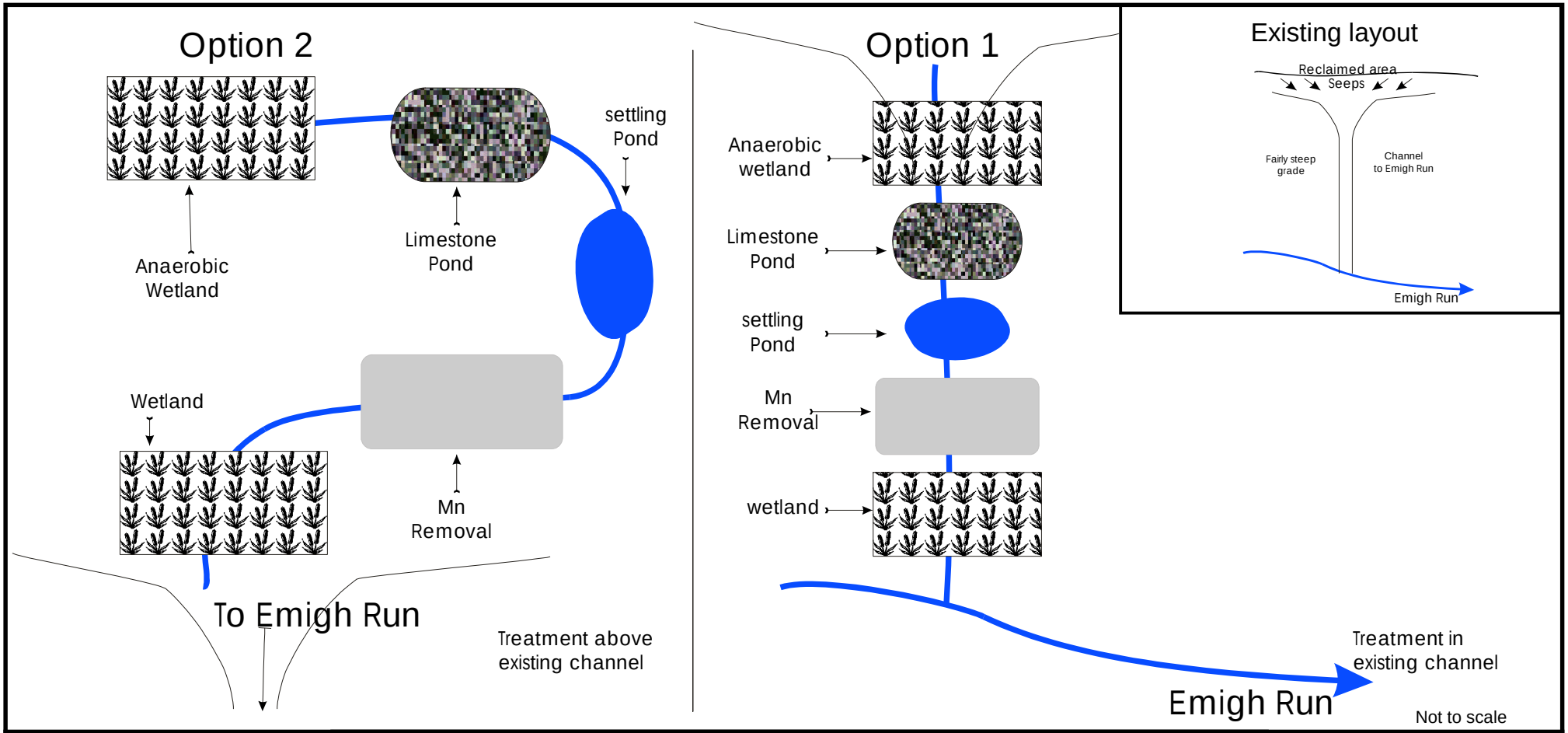
NewMiles of BlueStream NMBS

Proposed Treatment Systems on ER-6 Emigh Run Watershed

Prepared by:

NMBS
103 Fairway Drive
Philipsburg, PA 16866

www.newmilesofbluestream.com



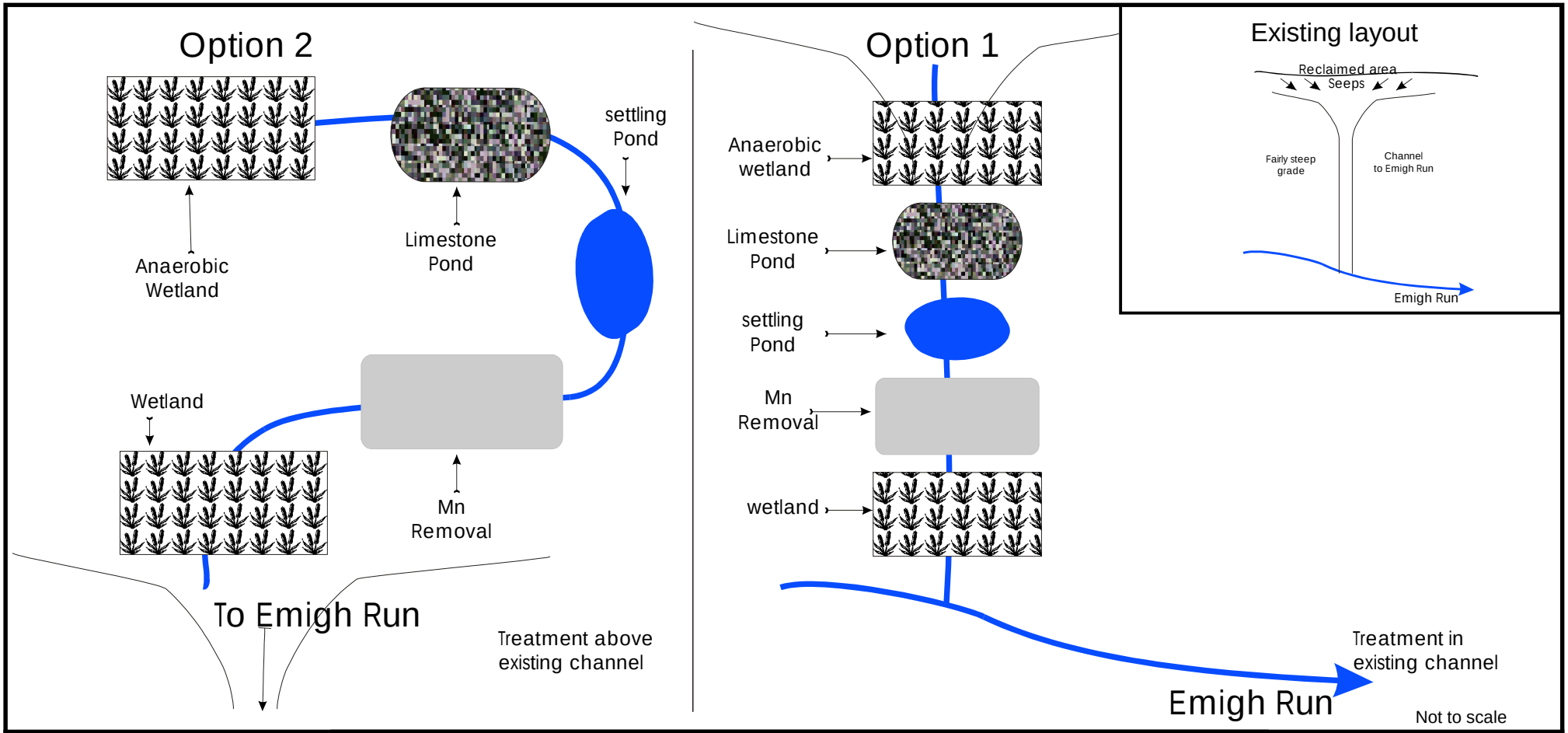
NewMiles of BlueStream NMBS

Proposed Treatment Systems on ER-9 Emigh Run Watershed

Prepared by:

NMBS
103 Fairway Drive
Philipsburg, PA 16866

www.newmilesofbluestream.com

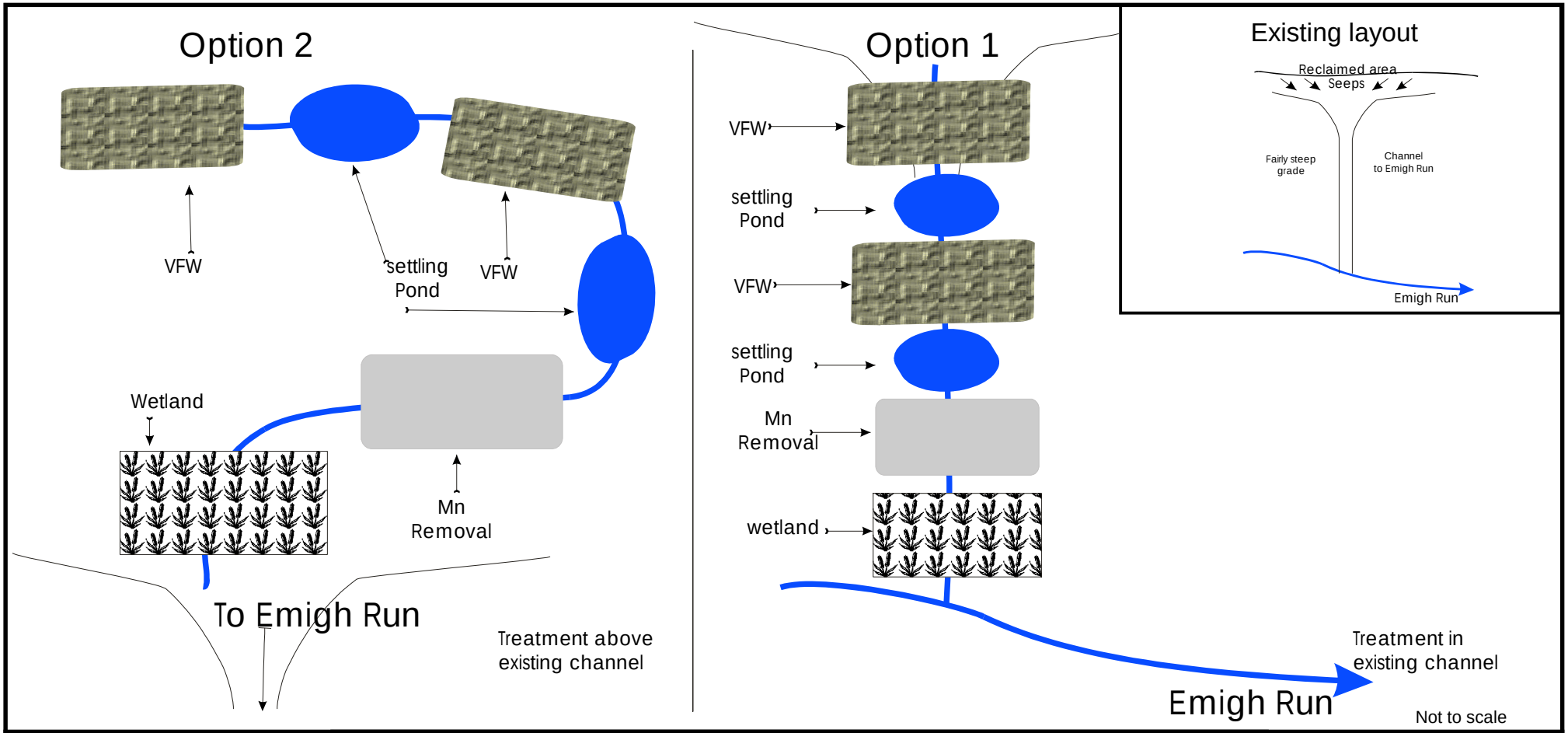


Proposed Treatment Systems on ER-10 Emigh Run Watershed

Prepared by:

NMBS
103 Fairway Drive
Philipsburg, PA 16866

www.newmilesofbluestream.com



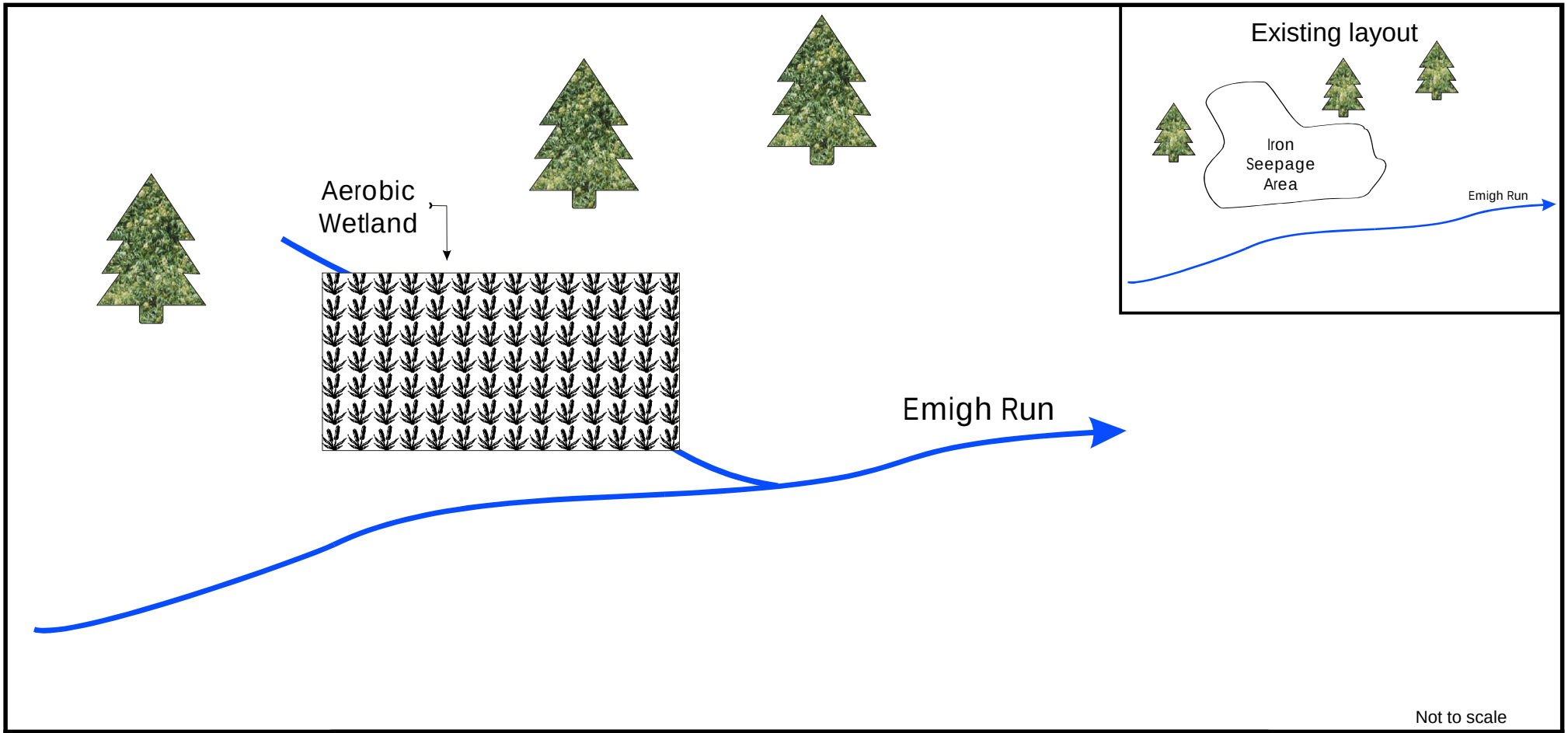
NewMiles of BlueStream NMBS

Proposed Treatment Systems on ER-12 Emigh Run Watershed

Prepared by:

NMBS
103 Fairway Drive
Philipsburg, PA 16866

www.newmilesofbluestream.com



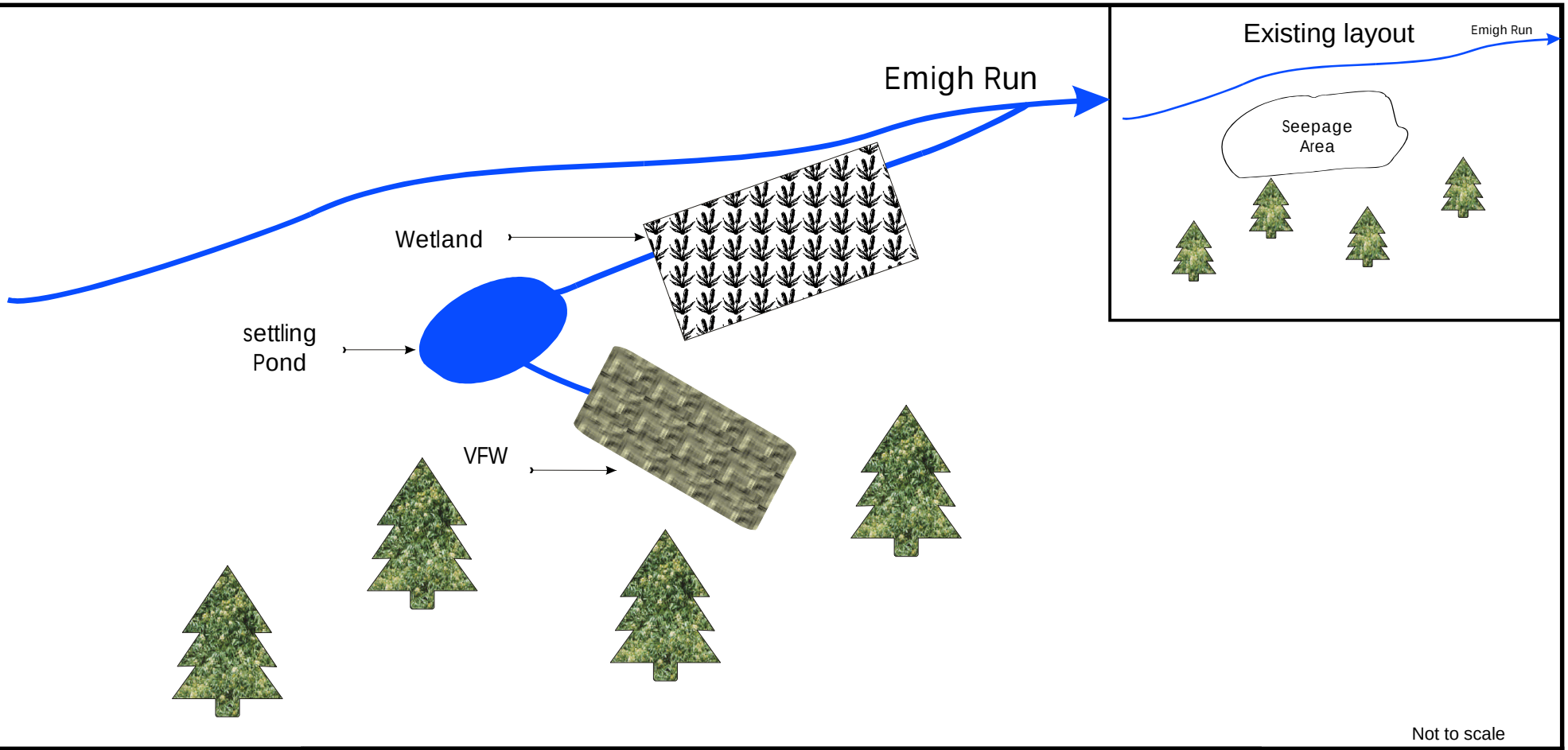
NewMiles of BlueStream
NMBS

Proposed Treatment Systems
on ER-30
Emigh Run Watershed

Prepared by:

NMBS
103 Fairway Drive
Philipsburg, PA 16866

www.newmilesofbluestream.com



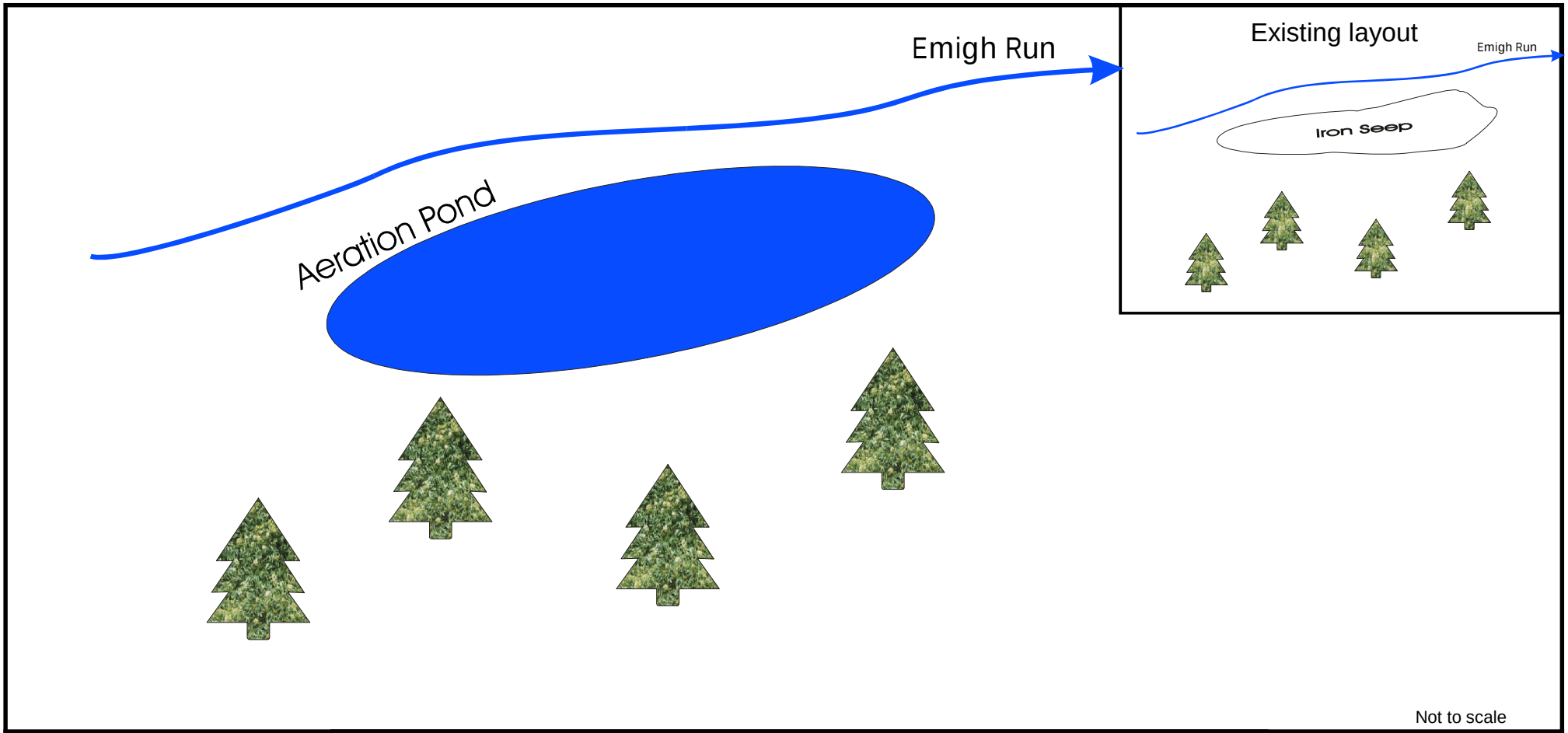
NewMiles of BlueStream
NMBS

Proposed Treatment Systems
on ER-31
Emigh Run Watershed

Prepared by:

NMBS
103 Fairway Drive
Philipsburg, PA 16866

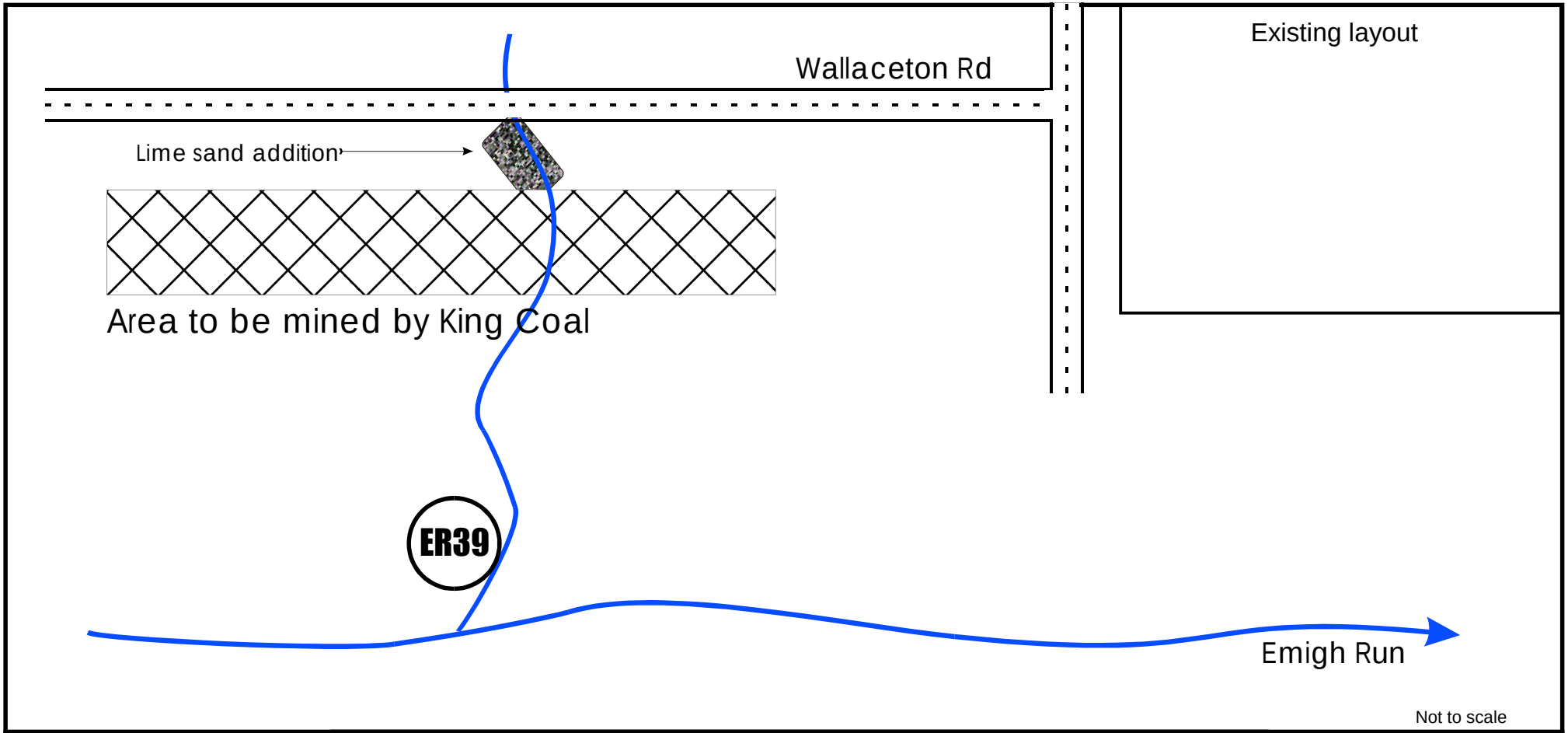
www.newmilesofbluestream.com



Proposed Treatment Systems
on ER-36
Emigh Run Watershed

Prepared by:

NMBS
103 Fairway Drive
Philipsburg, PA 16866
www.newmilesofbluestream.com

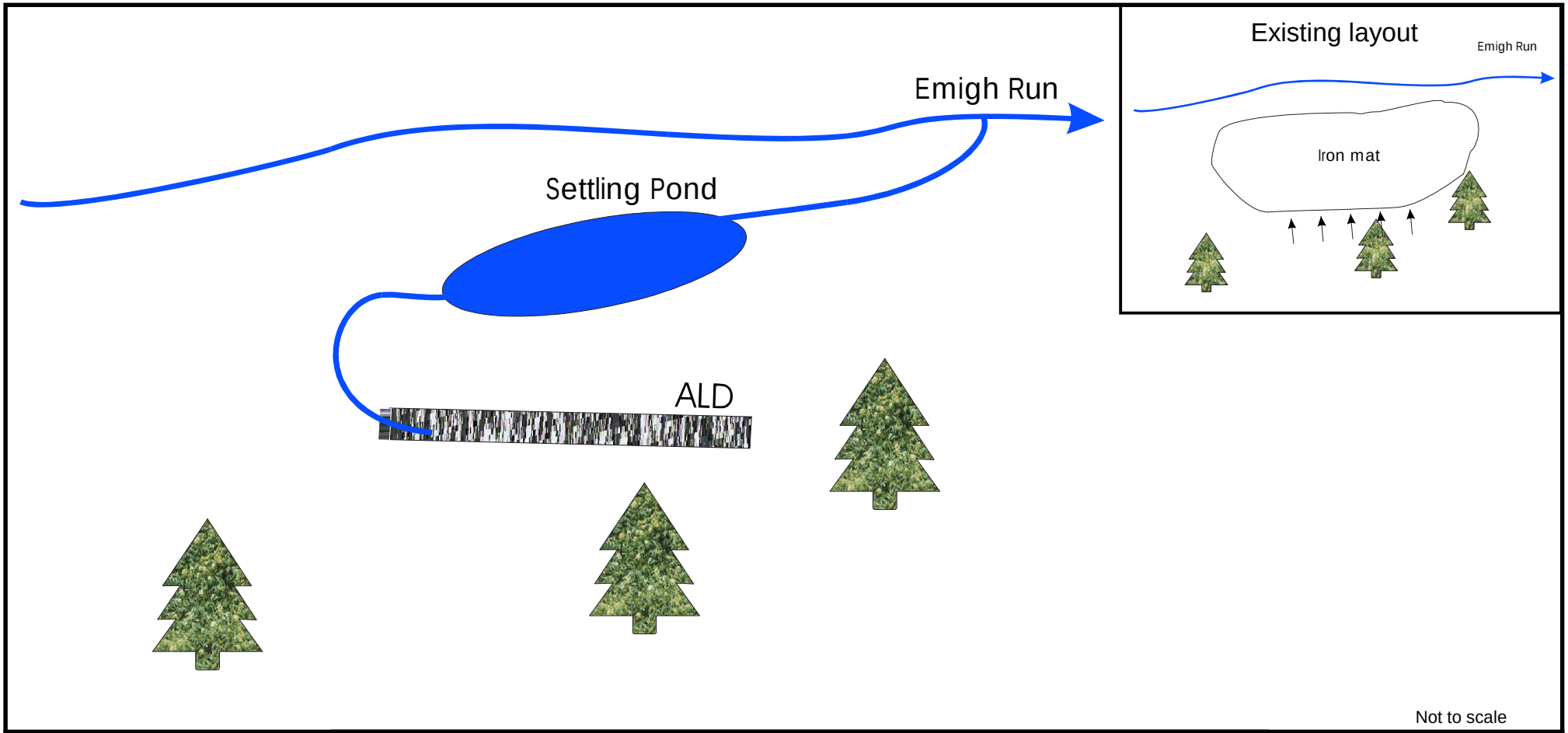


New Miles of Blue Stream
NMBS

Proposed Treatment Systems
on ER-39
Emigh Run Watershed

Prepared by:

NMBS
103 Fairway Drive
Philipsburg, PA 16866
www.newmilesofbluestream.com



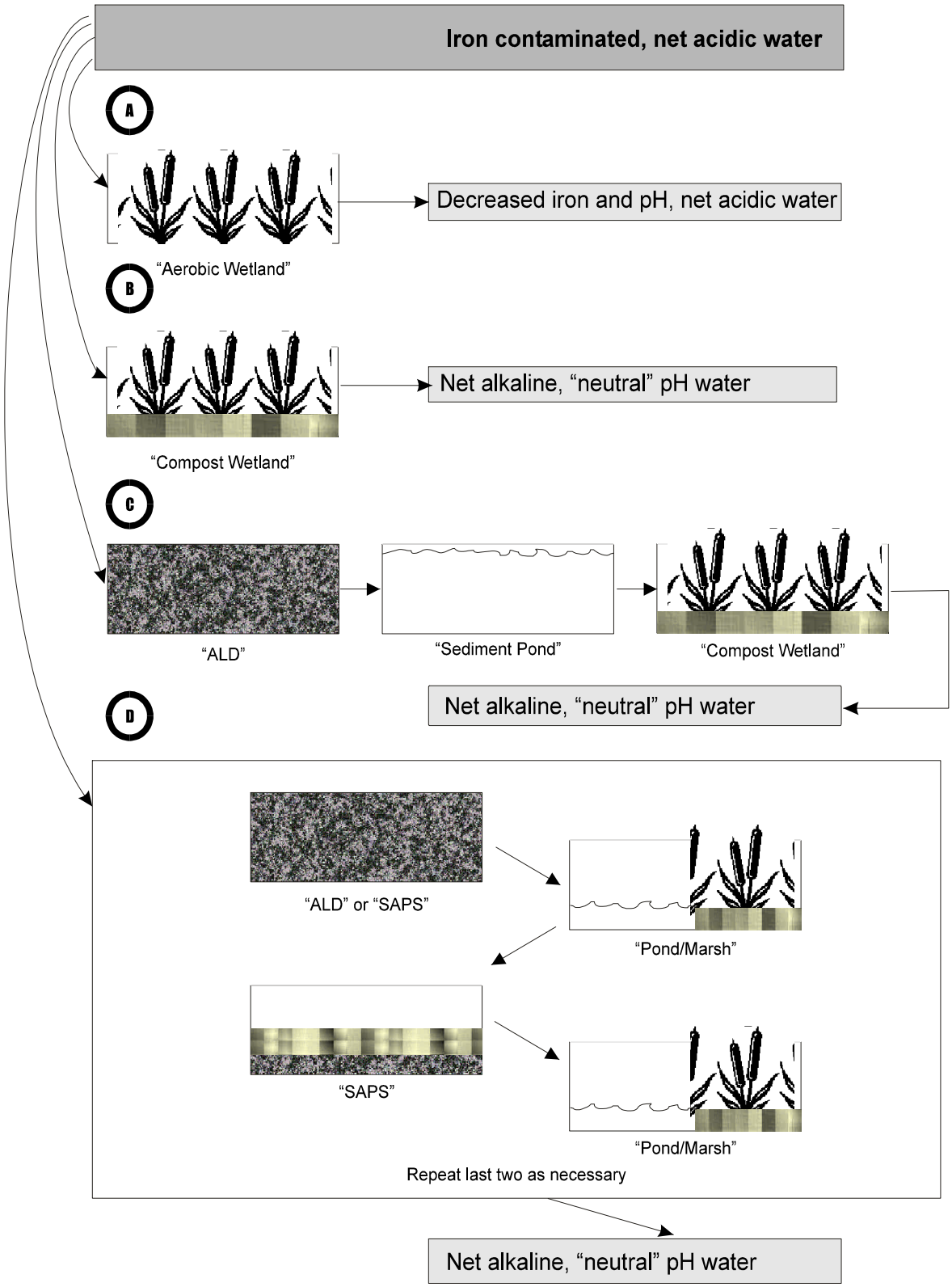
Proposed Treatment Systems
on ER-45
Emigh Run Watershed

Prepared by:

NMBS
103 Fairway Drive
Philipsburg, PA 16866

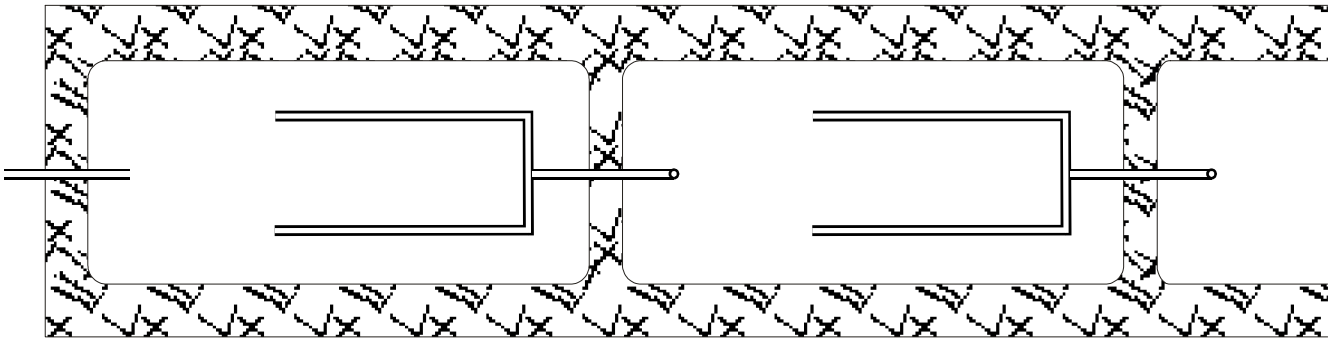
www.newmilesofbluestream.com

Evolution of Passive Treatment technology since 1980s

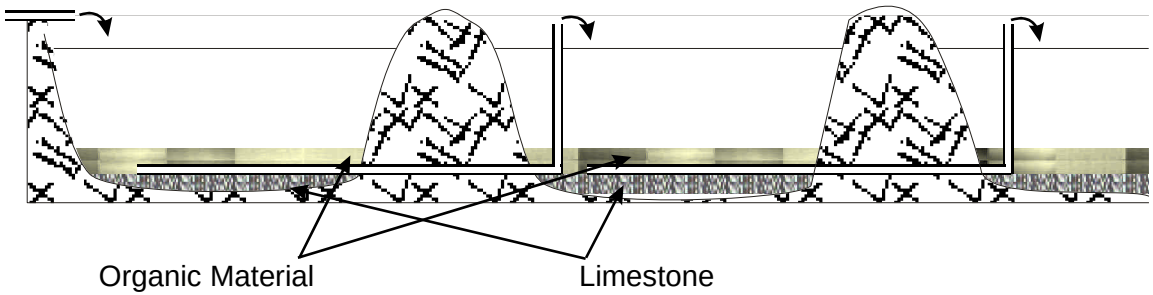


Views of a VFW system

A. Top View

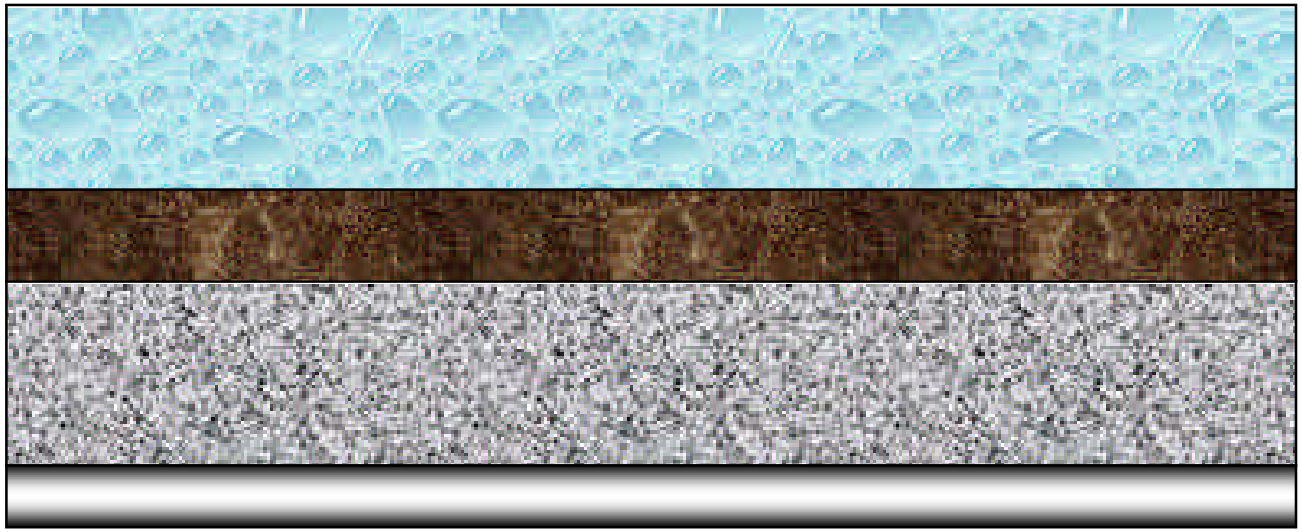


B. Side View

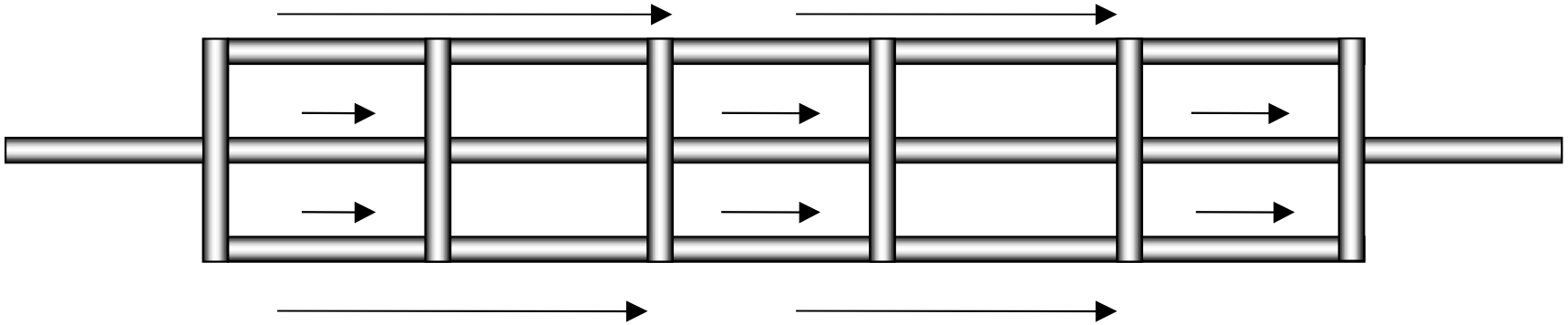


Cross sections of components of a VFW

Cross sections of a VFW



Cross sections of the piping layout in a VFW



Bibliography

Brodie, G.A., C.R. Britt, and T.M. Tomasczewski, H.N. Taylor. 1993. Anoxic limestone drains to enhance performance of aerobic acid drainage treatment wetlands-experiences of the Tennessee Valley Authority.

Cork, D.J. and Cusanovich, M.A. 1979. Continuous disposal of sulfate by bacterial mutualism. Microbiology. 20: 591-602.

Demchak, J., T. Morrow, and J. Skousen. 2001. Treatment of Acid Mine Drainage by Four Vertical Flow Wetlands In Pennsylvania. Geochemistry: Exploration, Environment, Analysis. 1: 71-80.

EPA. 1997. A Citizen's Handbook to Address Contaminated Coal Mine Drainage. #EPA-903-K-97-003.

Hedin, Robert S., Robert W. Nairn, and Robert L.P. Kleinmann. 1994. Passive treatment of coal mine drainage. Bureau of Mine Information Circular, US Dept. of the Interior.

Hedin, Robert. S., and George R. Watzlaf. 1994. The effects of anoxic limestone drains on mine water chemistry. Proceedings of International Land Reclamation and Mine Drainage Conference and the Third International Conference on Abatement of Acidic Drainage, Pittsburgh, PA. pp. 185-194.

Kepler, Douglas A. and Eric C. McCleary. 1994. Successive alkalinity producing systems(SAPS) for the treatment of acidic mine drainage. Proceedings of International Land Reclamation and Mine Drainage Conference and the Third International Conference on Abatement of Acidic Drainage, Pittsburgh, PA.

Nawrot, Jack R. and Willliam B. Klimstra. 1990. Biochemical treatment of mine drainage through a reedgrass wetland. Proceedings of Mining and Reclamation Conference and Exhibition, Charleston, WV.

Plummer, L.N., Parkhurst, D.L., and Wigley, M.L. 1979. Critical review of the kinetics of calcite dissolution and precipitation. In chemical modeling in aqueous systems-speciation, sorption, solubility, and kinetics (ed. E. A. Jenne). American Chemical Society Symposium, Series 93.

Robb, Gordon A. and James D.F. Robinson. 1995. Acid drainage from mines. The Geographical Journal. 161: 47-54.

Skousen, Jeffrey G. and Paul F. Ziemkiewicz. 1995. Acid Mine Drainage: Control and Treatment. National Mine Land Reclamation Center, West Virginia University.

Sverdrup, H.U. 1983. "The Limestone Wells at Piggeboda." Translation from the Symposium Proceeding "Kalkining av rinnende vatten." Alvesta, Sweden. pp. 11.

Glossary

Acidic: a condition where the concentration of positively charged hydrogen ions is high, and the pH is less than 7.0.

Aerobic: a condition existing or process conducted in the presence of oxygen

Alkalinity: a measure of the ability of a solution to absorb positively charged hydrogen ions without a significant change in pH. Also referred to as buffering capacity. Alkaline solutions have a pH greater than 7.0.

Aluminum: a common metal element found in mine drainage that oxidizes as a whitish precipitate at pH levels greater than 4.5.

Anaerobic: a condition existing or process conducted in the absence of oxygen.

Appalachian Clean Streams Initiative: a program sponsored by OSM to coordinate and focus mine drainage clean up projects in the United States.

BAMR: Bureau of Abandoned Mine Reclamation. Part of the Pa DEP.

Basic: a condition where the concentration of negatively charged hydroxide ions is high, and the pH is greater than 7.0 (alkaline)

DCNR: (Pennsylvania) Department of Conservation and Natural Resources

DEP: (Pennsylvania) Department of Environmental Protection

Dissolved Oxygen (D.O.): the amount of oxygen that is dissolved in a solution. DO can cause armoring on limestone by oxidizing iron compounds in mine drainage to form iron hydroxide.

Dissolved Solids: compounds in a solution that can be precipitated through chemical processes into solids.

Effluent: the solution that flows out of a basin, pond, tank, wetland, ditch, pipe, or other containment.

Environmental Protection Agency (EPA): the federal agency created by executive order in 1970 to coordinate efforts to protect human health and biological communities form environmental pollutants.

Ferric hydroxide: an iron compound that forms when dissolved iron in mine drainage is oxidized, and appears as a rusty, reddish-orange residue. It is often called yellowboy.

Flow Rate: the rate a solution moves through a ditch, wetland, pond, or stream defined in terms of quantity of mine drainage per unit time (i.e., 150 gallons per minute)

gpm: gallons per minute. See “Flow Rate”

Hydroxide: a compound containing the OH- molecule

Iron: a common metal contained in mine rocks in the form of iron sulfide that oxidizes as a reddish colored hydroxide solid.

Manganese: a metal found in mine drainage that oxidizes as a blackish stain.

Metal: elements that are solids, have few electrons in the outer shell, and lose electrons easily to form cations. Metals of concern in mine drainage are iron, aluminum, manganese, and sometimes lead, mecury, copper and zinc.

Neutral: a condition where the concentration of hydrogen ions equals the concentration of hydroxide ions, resulting in a solution that is neither acidic or basic and has a pH of 7.0.

Neutralize: to cause a solution to move toward a pH reading of 7.0 through chemical or biological processes.

NMBS: The name of the company that prepared this document. See www.newmilesofbluestream.com for more information.

O & M: Operations and Maintenance

Office of Surface Mining (OSM): the federal agency charged with enforcing SMCRA and dealing with health, safety and resource protection isues related to active mining and abandoned mine problems.

OSM: Office of Surface Mining

Overburden: the layers of rock and soil found above coal bed deposits. Overburden rocks often contain acid forming materials in the form of iron sulfide and other compounds that can form dissolved metals and sulfates.

Oxidation: a reaction in which a substance losses electrons. In the case of mine drainage metals oxidation, the oxidizing agent is gaseous oxygen. Metal oxides are formed in the process.

PADEP: Pennsylvania Department of Environmental Protection

Permeability: a measure of the rate of water movement through soil or other substance.

PFBC: Pennsylvania Fish & Boat Commission

PGC : Pennsylvania Game Commission

pH: a value, expressed as standard units on a scale of 0-14, that uses a logarithmic measure to express concentrations of hydrogen ions. pH readings below 7.0 are said to be acidic, and readings above 7.0 are basic or alkaline.

Porosity: the ration of volume of voids to the total volume of material. Used to describe the ability of a fluid to move through crushed rocks or other material.

Pre Act mining: mining that occurred prior to the passing of SMCRA in 1977.

Pyrite: the iron sulfide mineral, often called “fools gold” that is found in earthen and rock layers near coal seams. Pyrite is the usual source of the sulfur that binds with hydrogen and oxygen in rain water to form the sulfuric acid component of mine drainage.

Reduction: a reaction in which a substance gains electrons. In mine drainge treatment, reduction usually involves stripping away of oxygen atoms from sulfate or metal compounds.

Residence Time: the length of time that mine drainage remains in a treatment pond, wetland, or other structure. Designed residence times depend on incoming flow rate, the rate of treatment process in the structure, the contaminants in the mine drainage to be treated, the size of the structure, and the settling rates of solids in the discharge.

RMEF: Rocky Mountain Elk Foundation

Sedimentation: the process whereby particles settle out of solutions. Sedimentation produces a sludge or other layer of solids at the bottom of a sedimentation or settling pond.

SGL: State Game Lands

Sludge: the laer of solids that settle from a solution, including suspended silt and soil particles and precipitates formed by chemical processes.

Solubility: the amount of material that can dissolve in a given amount of water or other solvent at a given temperature to produce a stable solution. Highly soluble substances dissolve quickly. Soluble products will not settle out of a solution unless they are precipitated.

Substrate: the rich, organic layer of compost or other material found at the bottom of wetlands.

Sulfates: compounds containing sulfur and oxygen. Elevated sulfate levels are common in mine drainage. Sulfates can bond

with hydrogen ions to form sulfuric acid or bind to calcium atoms to form a gypsum solid.

Surface Mining Control Act of 1977 (SMCRA): the federal law that requires mining operations to prevent water pollution, reclaim mine lands and protect other sources.

Suspended Solids: solid particles that are suspended in solution. Suspended solids in mine drainage can include oxidized metals, silt or soil and other tiny debris particles.

TDS: Total Dissolved Solids

TMDL : Total Maximum Daily Load

Topographical Map: a map that shows land elevations by use of lines that connect points of equal elevation, water bodies, streams, buildings, mine sites, roads, and other land features.

TSS: Total Suspended Solids

UT: Unnamed Tributary

Vertical Flow Wetland (VFW): specialized mine drainage treatment ponds that make sue of chemical and biological processes to treat the acid, metals, and sulfate found in mine drainage.

VFW: See Vertical Flow Wetland

Watershed: an area of land from which water drains toward a single channel.

WPA: Works Progress Administration